Standard Size, 9 x 12. DECEMBER 7, 1905. Price Ten Cents.

AMERICAN MACHINIST

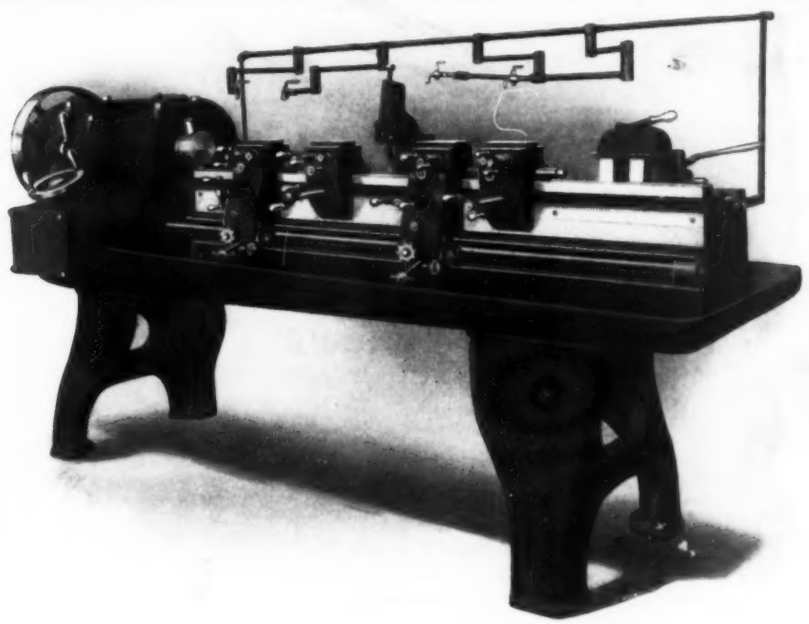
A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY,

Vol. 28. 505 PEARL STREET, NEW YORK. No 49.

Index to Advertisers and Classified Index Following Reading Matter.

LO-SWING LATHE



Working Range—any diameter ranging from ½ inch to 3½ inches, and all lengths under 60 inches. Four carriages may be simultaneously in operation at four different shoulders. The work is supported by a combination of the engine lathe center points and turret lathe back rests.

Low Swing.
Single-slide tool support.
Metal-to-metal tool support.
Cutting tool held down close to guiding rail.
Solid metal between the tool and the lathe bed.
Working stress holds carriage squarely on its guiding rail.
Four carriages, each only 5 inches wide.

Adjusting screw for controlling diameter is directly back of the cutting tool.
Carriages weigh 40 and 60 pounds instead of 350 or more.
Ideal combination of engine lathe centers and center rest with turret lathe back-rest for work control.
Gears and clutches run in a shallow basin of oil in headstock.
Geared head, constant speed drive.

Send for book on the "Lo-Swing." Manufactured and sold exclusively by the

FITCHBURG MACHINE WORKS FITCHBURG, MASS., U.S.A.

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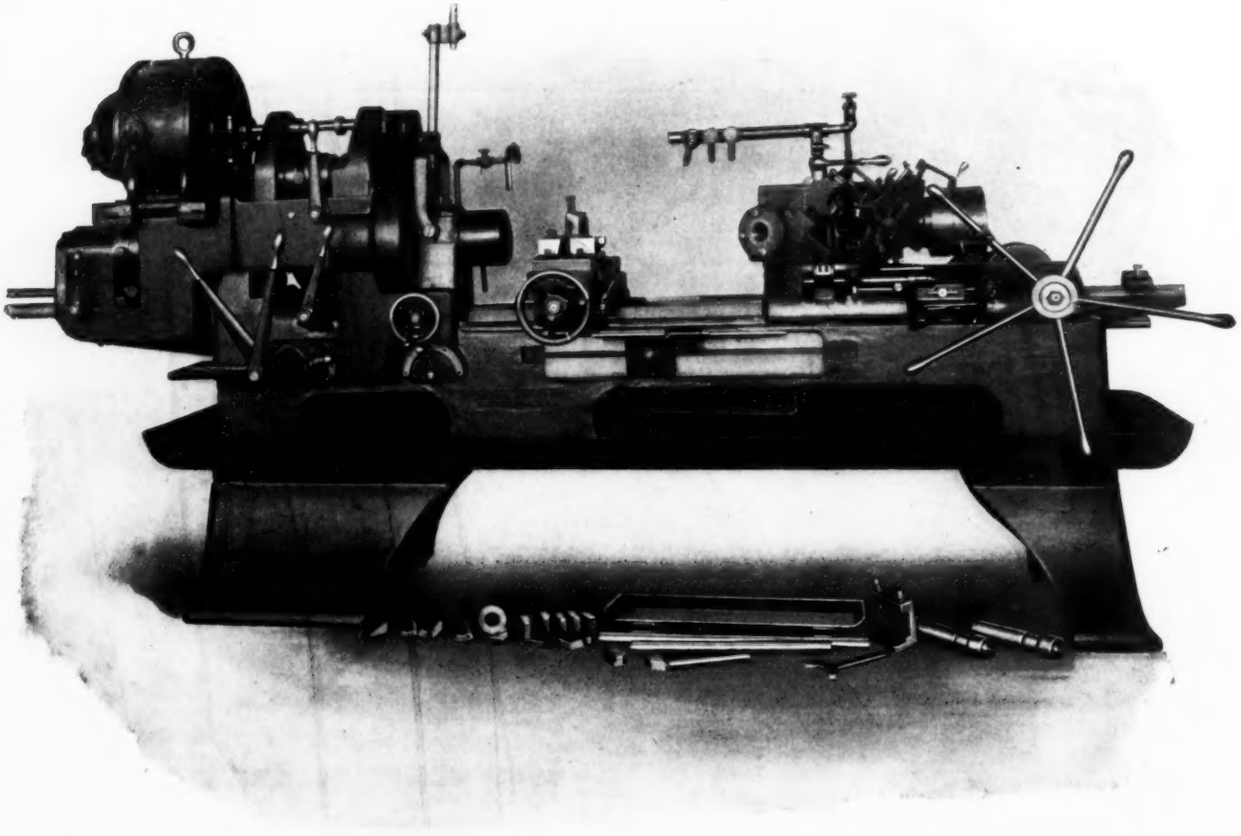
FIVE SIZES

5/8" x 4½" 1" x 10" 1½" x 18" 2" x 26" 3" x 36"



3 x 36 inch Pratt & Whitney Turret Lathe, driven by 5 h.p. motor.

The motor drives through a speed box which, with the double friction back gears, affords a wide range of speeds. The same type of motor drive is used also on our 1½ x 18 inch and 2 x 26 inch machines.

Cross and longitudinal power feeds are positive geared, reversible, and have automatic stops in either direction.

The cross-slide permits the use of larger forming tools than can be held in a turret and makes possible the use of three cutting-tools at one time.

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A Lever Milling, Drilling and Reaming Machine.

EDITORIAL CORRESPONDENCE.

The Monotype contains a series of levers connecting its cams with the parts moved by them. These levers are of various lengths and forms, as shown in Fig. 1, which represents a side view of them. They must be accurately made and by manufacturing methods. If inaccurate, they offer limitless possibilities for trouble, and the readers of the AMERICAN MACHINIST will agree that to make them satisfactorily with the aid of the usual facilities of even the best shops, would be a difficult and expensive undertaking.

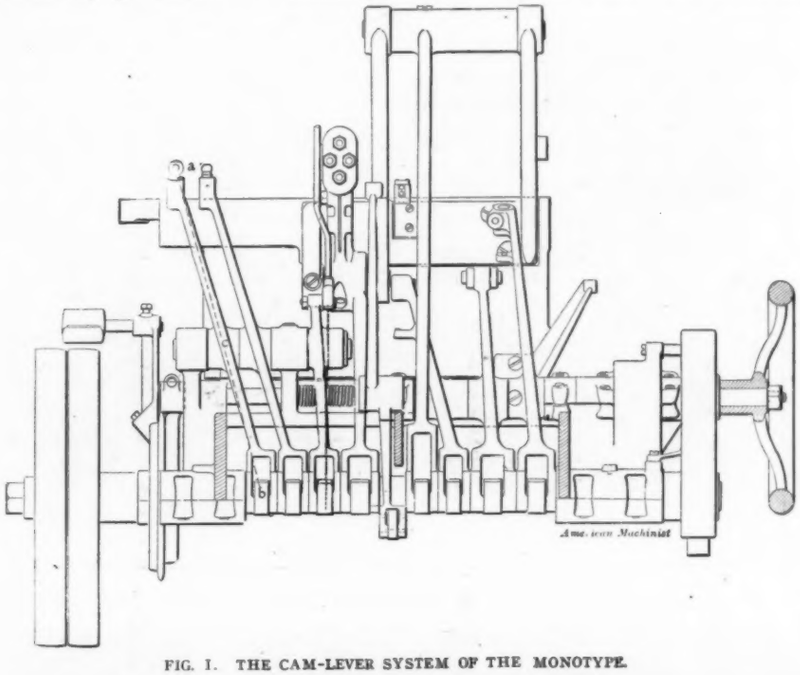

FIG. 1. THE CAM-LEVER SYSTEM OF THE MONOTYPE.

Figs. 2 and 3 illustrate a special machine for these parts, which was made by William Sellers & Company. It consists of a bed, of lathe style, and two heads, also essentially of lathe style. The spindles are fitted to carry a series of milling cutters for the various operations, while the cutter arbors are hollow and fitted to receive taper shank drills and reamers for the holes of the levers. The levers are held in suitable jigs, which are mounted on the carriage of the machine, and a set of stops is provided by which the distances between holes, as well as the various offsets of ends and center bosses, are positively determined.

Fig. 2 shows the machine in the act of milling the jaws which embrace the cam roller. A gang of mills faces four surfaces simultaneously. This gang does not include the smaller cutter at the end of the arbor, the object of which is to face the end of the center boss on the side of the lever opposite the observer. After milling the surfaces of the end jaw, the work will be withdrawn from the cutters, the carriage will be traversed on the bed and the work then be fed forward to present this boss to the small cutter. One of the stops for determining the offset of the boss and end jaws is shown under the right-hand head in Fig. 3, albeit this is not the stop used in the operations shown in Fig. 2. The stop used for those operations is precisely like the one shown but located on the other head, and hence out of sight. Distance rods are laid on the bed abutting between the screw stop and the work carriage, a rod being provided for each cut to be taken, and by changing rods between cuts the work is positively located for the cuts.

Fig. 3 shows the machine in the act of reaming the hole through the end jaws, which are shown as being milled in Fig. 2. Prior to the finish reaming, the hole was drilled and rough reamed, the tools being changed quickly through the use of a ball-ended rod running through the hollow spindle. After finishing this hole, the reamer will be removed and the right side of the center boss will be faced by the cutter on the right-hand spindle, when drill and reamers will be again brought into play to make the hole through this boss.

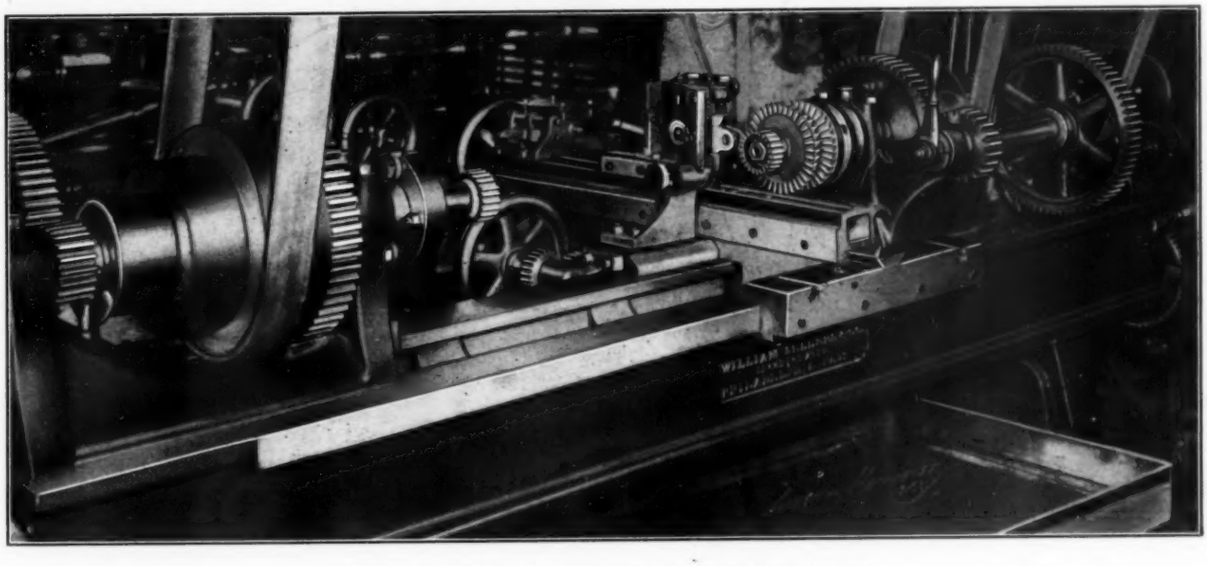

FIG. 2. LEVER MILLING, DRILLING AND REAMING MACHINE.

The distance between these holes is determined by a stop pin attached to the work-carriage saddle by a bracket clearly shown, which pin engages with notches in a steel strip attached to the jig. The lever shown has but two holes, but some of them have three, and in these cases the steel strip has a third notch for locating the third hole. The rear boss of such a

lever would obviously be faced by the smaller cutters on the spindles.

The feed in all directions is automatic, the endwise drilling feeds being taken lathe fashion from a splined rod below the carriage, and the cross-milling feeds from a telescopic universal jointed shaft connecting the end of the carriage with the end of the bed of the machine, where both feeds are driven by an independent belt, shown in both Figs. 2 and 3. The variation of the feeds is by a Sellers friction disk. The feeds have also automatic throw-outs, by which one man is enabled tc operate two machines.

The form of the jigs used is shown in Fig. 4, which also gives a view of some of the levers, and shows again the multifarious forms which have to be dealt with. The lever shown in the jig has three holes, and the jig tail at the right has three distance notches, though these are on the opposite side from the observer.

The lever casting is held in the jig by a method which insures that it shall not be distorted by the binding screws. Two screws only bind it vertically, while two clamp pieces bind it horizontally, and the anvils against which the lever rests being directly opposite the points of applied pressure, there can be no distortion. The piece is located endwise by an abutment with which the center boss contacts.

An examination of Fig. 1 will show a feature of these levers which is commonly ignored in designing such pieces, but which is here scrupulously incorporated in all. Taking the extreme left-hand lever for example, the center of the ball *a* at the operating end, the center of the roller *b* and of the bearing *c* are on a straight line, as indicated by the dotted center line of this lever, and also of the second one to the right of it. The principle is that, however much it may be necessary, for structural reasons, to have the metal of such a lever depart from a straight line, there should be no departure on the part of its three bearings. The ignoring of this simple and obviously correct principle, gives rise to many constructions which Professor Sweet might well have included in his collection of "things that are usually wrong." For a common and flagrant example of such wrong construction, see almost any intermediate rock lever of a Corliss engine. The machine shown is the design of J. Sellers Bancroft, general manager of the Monotype works. F. A. H.

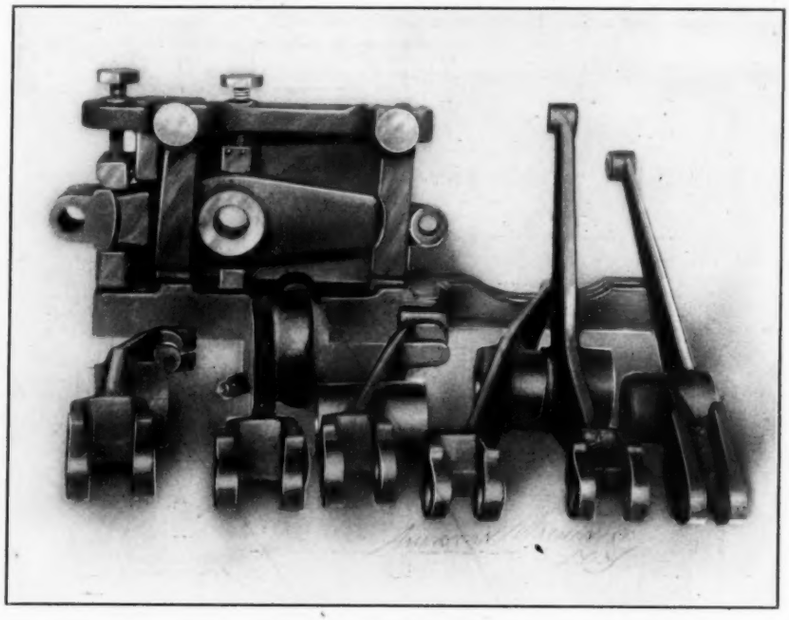

FIG. 4. LEVERS AND JIG.

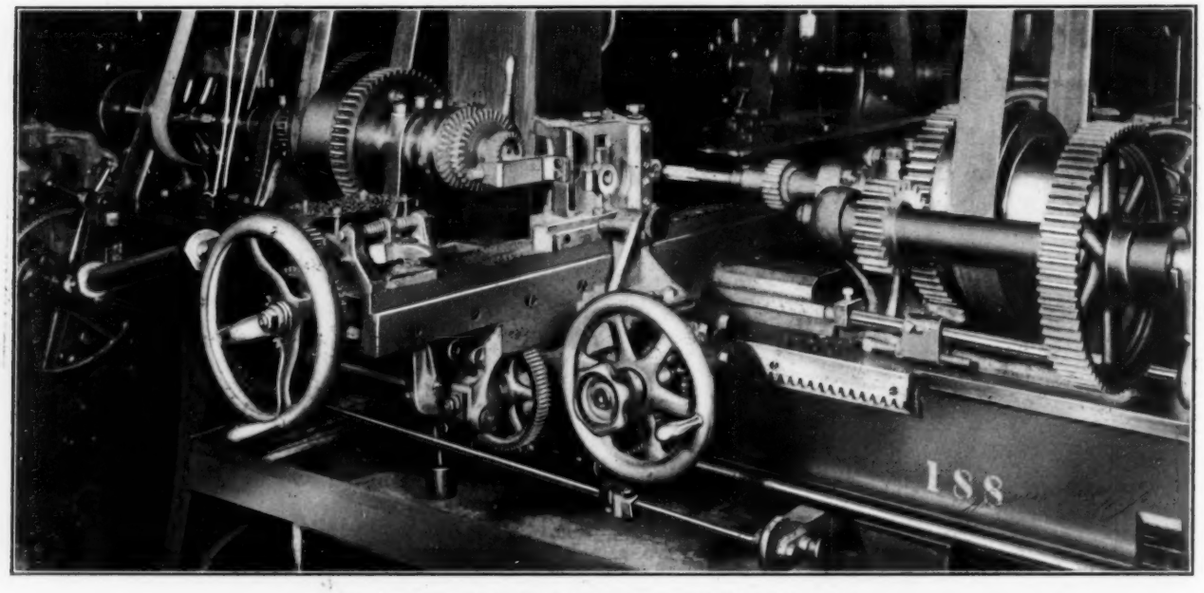

FIG. 3. LEVER MILLING, DRILLING AND REAMING MACHINE.

The public has somehow got into the way of regarding the steam turbine and the reciprocating engine as deadly rivals; it therefore comes as a surprise to learn from *Town* that a combination of the two prime movers is actually being carried out, the piston dealing first with the high-pressure steam and the turbine taking it on its way to the condenser. The turbine is recognized as "enormously effective on the vacuum end of the diagram, while the piston beats it on the high-pressure end." The experiment will be full of interest not only with regard to the possible economy of steam, but also in the problem it offers in the union of two movements which differ so greatly in velocity.—*The Indian Textile Journal.*

Incandescent mantle gas lamps for street lighting are to be substituted for electric arc lamps in the city of London.

Folding or Bending Dies.

BY CARROLL ASHLEY.

One of the things that oftentimes prevents the successful manufacture of a sheet-metal article is the difference in the thickness of the metal after it is drawn to shape; that is, when the die stretches or distorts the metal, the stock is thinner at that identical point.

It is almost impossible for a die designer to tell just what a piece of metal is going to do by drawing it over a square or round corner and forcing it into a box die, no matter how experienced he may be; but with folding dies it is entirely practicable for him to lay out on paper not only the forming die but, in most cases, the blank, before it is given to the toolmaker to be worked upon, thereby saving the time-killing operation of finding the blank. I remember the first set of finger dies I ever saw. The drawings came into the shop for the usual form of a box die, and it was the workman who suggested the construction of the finger mechanism, which in this one instance saved the making of two extra forming dies, thus cutting down the number of operations in the manufacture of the article.

The folding or bending of aluminum especially is accomplished with dies of similar construction to those here described, without stretching or distorting the metal.

When it is required that pieces like Fig. 1 should be manufactured in large quantities with the ends formed perfectly square to the body of the blank and of uniform thickness and length, regardless of a variation of thickness of stock before working, say of .005 inch over or under, the most natural way to do the job would be to fold it over, the same as by hand. That is, to start at the ends and work in, the center being held down tightly by a pressure pad, and, as the die proceeds on its course, the fingers or punches being brought toward the center by means of blocks or heels fastened to the shoe of the die. The fingers or punches are made to swing on pins, the motion outward being limited by the part above the pin striking against the punch-holder.

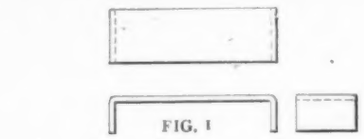

FIG. 1

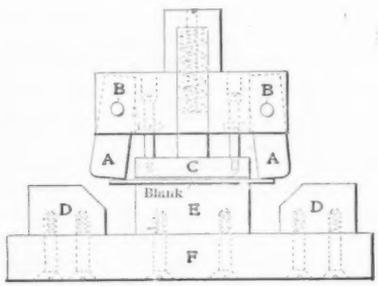

FIG. 2

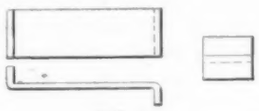

FIG. 3

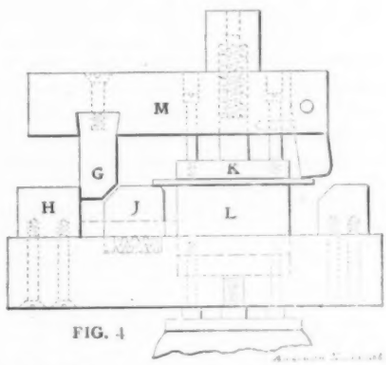

FIG. 4

FOLDING OR BENDING DIES.

Referring to Fig. 2, the swinging members are shown at *A*, pivoted on pins *B*. *C* is the pressure pad, and *D D* are heels which force the swinging fingers toward the block *E*. *F* is the die shoe. The sketch shows double punches, but this type of tool can be constructed with one, three or four fingers as well as two.

In this construction there is no tendency for the die to shift on the bed of the press, as all the parts are self-contained.

Suppose a piece is required to be formed like Fig. 3—that is with one end up and the other end down. In this case it will be necessary to have a double pressure pad, one operating from the upper and one from the lower die. A glance at Fig. 4 will show that this die is built at the right-hand side the same as the one in Fig. 2, but on the other side the punch *G* enters between the heel *H* and sliding block *J*; this forces the latter toward the pressure pad *K*. As the die begins to operate, the pad *K* comes in contact with the blank to be formed, which is located on the lower pressure pad *L*, and the swinging punch then begins to work, folding the piece down until the pad *K* comes in contact with the punch holder *M*, when the lower pressure pad begins to descend, thus forming up the other end; then the sliding block *J* is driven inward by the punch *G* and the piece is finished.

This style of die can also be used to bend up a blank like the one shown in Fig. 5; that is, the ends opposite each other are turned in the same direction.

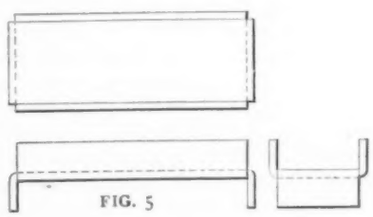

FIG. 5

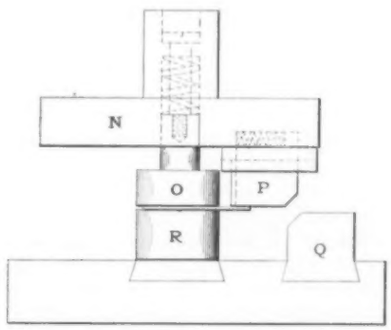

FIG. 6

FIG. 7

FIG. 8

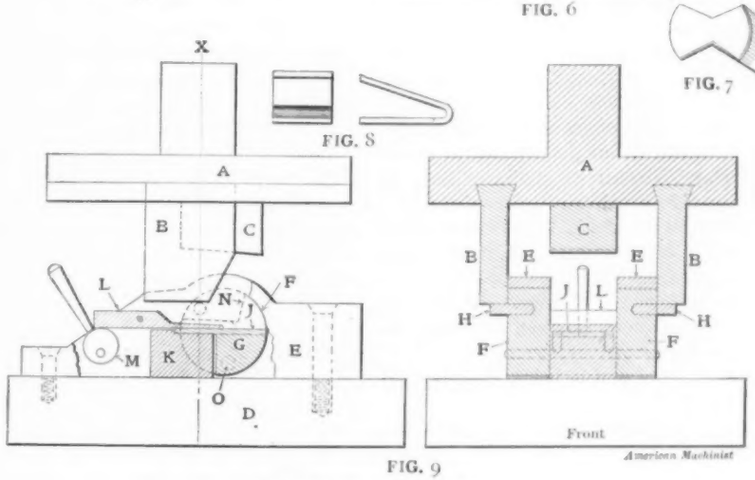

FIG. 9

FOLDING OR BENDING DIES.

Fig. 6 shows dies for bending and embossing at one stroke of the press. In the punch holder *N* are located a pressure pad *O* and a sliding block *P*, which is held in position by gibs on its sides; and a coil spring works against a lug on block *P*, thus keeping it always to the outside when

not in operation. The heel *Q* drives the sliding block *P* against die block *R*, which is dovetailed into its base. It would be possible to emboss the plain part of the blank between the pressure pad *O* and the die block *R*. The blank for this design of die is shown at Fig. 7.

Dies for making the first forming and nipping operations on hinges and other work of similar nature, can be built by using the principle shown in Fig. 2.

Fig. 8 shows a piece to be made out of spring brass. Now to form a blank in this shape by forcing it down into a hole is a losing operation, as 25 per cent. will be lost by breaking of the metal at the apex, and the ends will be of unequal length no matter how much pressure is used to prevent this. By constructing a rotary die like Fig. 9 there will be no breakage and the ends will always come uniform. On the punch holder *A* are fastened two fingers or drivers B^1 and a flattening punch *C*. On *D* are fastened two pieces *E*, *E*, seen to better advantage in the sectional view. Within the circular openings of these pieces is the rotary part *F* of the die, and the cross-hatched portion *G* is a part of the rotary member. Permanently seated in *F* are the pins *H H;* the blank is shown at *J* placed in position for the operation, on block *K*. A hold-down lever *L*, actuated by the cam lever *M* holds one end of the blank in a positive manner until the operation is completed. The arms *B*, as the punch holder comes down, strike pins *H*, give *F* a rotary movement, and bend the end of the blank around until it strikes the top side of the hold-down lever *L*. By the time *G* has reached the position indicated by dotted line *N* in the side elevation—there being nothing as yet to retard the downward movement of the punch—the pins *H* have traveled around from their starting point to the end of their travel at *O*, and are in contact with the beveled edges of fingers *B;* but at this point punch *C* comes into play. The stroke of the press is set so that this punch strikes on the top of *G* and sets the blank, thereby completing the operation. As the punch rises, seat *G* is returned to its normal position by a spiral spring not shown. It will be noticed that an embossing operation can also be performed by the rotary part *G*, the pressure for this being furnished by the punch *C*.

When it is necessary to get an absolutely square corner out of stock that has some spring to it, the sides facing the swinging punches or fingers can be undercut and the punches constructed to drive the stock further in.

Zinc roofs are deservedly coming more into prominence. Owing to the layer of oxid which is formed upon the zinc by the influence of the atmosphere and which effectually protects the underlying metal, zinc is the ideal metal for roofing purposes.

The Realization of Ideals in Industrial Engineering.*

BY H. F. J. PORTER.

In the specialization process evolved by the severe competition in the industrial world during the past half century, engineering has possibly suffered as much cleavage as any of the other professions. Our section of Mechanical Engineering was one of the earliest results of this action, and through the fostering influence of the technical school which came into existence almost simultaneously, it prospered and rapidly assumed characteristic features which were readily distinguishable. Seeming to include the essentials required by manufacturing industry which was steadily growing and at the same time becoming continuously diversified, this section in turn responded to the pressure of the refining process, yielding many subdivisions.

THE NEW SUBDIVISION OF ENGINEERING.

One of the most recent of the latter developments has been accorded considerable attention by this society at its recent meetings, although as its scope and limitations have not as yet had time to become defined, it does not seem to have reached an exact status. Its adherents therefore, responding to their individual preferences or qualifications gained by personal experience, have individually assumed titles illustrative of the line of their immediate practice, such as Industrial, Commercial, Organizing, Manufacturing, Production, and Modernizing Engineers. The Engineering Index classifies literature written by these men under the caption of Industrial Economy. Colleges have established departments intended and destined to embrace the fundamental principles of the new profession under the name of Schools of Commerce.

Some of the experts in this field devote their attention to perfecting office and accounting systems and making methods of organization and management more efficient, while others are engaged in the refinement of processes of manufacture and shop practice, in order to simplify and increase production and reduce its cost; and inasmuch as office and shop are very intimately related, these lines of work frequently cross and overlap each other.

These men are doing work as to the necessity of which there is no question. They have come into existence in response to an urgent demand, and the efficacy of their work in meeting it is evident wherever it is performed. Their efforts are directed toward the scientific study of problems in office and shop practice the economic value of which has been heretofore overlooked. There is as yet no book which treats of the whole field of their activity, although there are many monographs covering the special features of their practice. There is, however, in these latter writings an acknowledgment of the basic fact that, to secure the ultimate efficiency of the working organizations in both office and shop, the human element in each must be accorded recognition.

*Presented at the New York meeting (December, 1905) of the American Society of Mechanical Engineers.

CHANGED CONDITIONS.

It is this feature of the broad field of what I shall here term Industrial Engineering that I desire to bring to the attention of the society in this paper, and I do not think the subject has been referred to except parenthetically at any previous meeting. We have insensibly drifted away from the patriarchal system of management which existed as late as twenty-five or thirty years ago, in which the owner of a shop was manager, superintendent and workman, who knew little about shop organization but associated with his men on intimate and cordial terms. As manufacturing plants have grown in size and the workmen have differentiated their trades, a type of military organization has gradually developed in the shops in which the manager, superintendent and foremen are officers who, instead of being expected to take part in turning out the product of the plant, are, on the contrary, experts in shop management, and see that the machine of which the workmen are parts is kept in proper working order. In this way the old personal touch between master and men (which terms still adhere in English shops) has disappeared entirely. But human nature has not changed. That element still exists in the organization, and if the full strength of the latter is to be secured it must be accorded recognition. The writers above mentioned say that no matter how perfect may be an accounting system, if it is carelessly or unintelligently applied, it becomes worse than worthless because it will be misleading in its results; that no matter how perfectly suited to their purpose the machines or efficient in quality or shape the cutting tools, unless they are skilfully manipulated the product will be unsatisfactory, and so in either case the outcome of an enterprise possessing mediocre talent in its working forces will be jeopardized. In order then to insure a successful issue to a manufacturing venture we must look beyond the mechanical assets to the qualifications for efficient service possessed by the organization of supervisors, clerks and operatives; and it will be found that the measure of success attained will be determined by the standard of excellence of those qualifications.

ORGANIZATION VS. EQUIPMENT.

I do not wish, however, to be understood as underrating the value of a high-grade mechanical equipment, for if success is to be attained the equipment must be the best of its kind for the purpose. But I do wish to emphasize the greater

necessity of possessing as highly efficient an organization as can be secured; for a capable organization can make the best of a poor equipment and produce good results, whereas an incapable organization will not only fail to make a fine equipment productive of good work, but probably in a short time will destroy the equipment itself.

MR. CARNEGIE'S OPINION.

In his paper on "Shop Management," presented at the Saratoga meeting in June, 1903, Fred W. Taylor quotes the attitude on this point taken by Mr. Carnegie, whom he designates as having been one of the most successful manufacturers of this country, and therefore to be considered as an authority on organization and management. Mr. Carnegie, when asked by a number of financiers whether he thought that the difference between one style of organization and another amounted to much, providing the company had an up-to-date plant properly located, said in effect that should some great catastrophe destroy all of his mills but spare his organization, which had required many years to perfect, he might be inconvenienced temporarily, but that he could depend upon his organization to re-establish his business. If, however, he should lose his organization, even if his mills, which were the best in existence, were left intact, he would not have time nor strength to rehabilitate himself in the business world. Just as we have, for instance, recently seen it demonstrated that opposing armies and navies may have exactly the same guns, but that the side which has behind those guns the men of superior physique, character, intelligence and skill will win the battle, so also it has been proven that it is not the tool that determines either the quantity or quality of product, but the qualifications for efficiency possessed by the man behind the tool who controls and directs it.

The lesson taught generally by the foremost enterprises of the day, in their respective industries, is that their success has been largely due to the efficiency of their working forces. Thus in recent years the importance of possessing a high-grade organization has impressed itself more and more upon the mind of the business manager, so that at the present time this possession is considered, by those who are most competent to judge, by far the most valuable of all commercial assets.

ONE ABLE MAN NOT ENOUGH.

Considering for a moment the functions of the organization, together with its circumscribing limitations, it must be recognized initially that if one man autocratically dominates it its scope of expansion can never be any greater than what he can himself devise. Also that the character of work which may be realized from the organization as a whole will be no better than can be produced by the individuals that compose it.

If honest workmanship is desired, honest workers will be necessary for its accomplishment; if quantity of output is expected, skill and enthusiastic devotion to duty must be possessed by the operatives; if improvement in processes and perfection of product are to be hoped for, the workers must have intelligence and be given suitable opportunities for its expression; if the organization as a whole is expected to grow, not only in size but in strength and character, facilities must be offered for the improvement of the individuals and inducements made for taking advantage of them; if untiring aggressiveness against competition is desired, absolute confidence in the enterprise and its product will have to be developed in the organization; and if harmonious co-operation between departments and management is to be effected, a spirit of mutual helpfulness must be imbued in the individuals comprising them respectively.

QUALIFICATIONS NEEDED.

What then are the qualifications with which a high-grade organization should be endowed in order to attain a high standard of efficiency? Inasmuch as, after all, an organization is but a collection of human beings, it stands to reason that if as an entity it is to be of high grade, the units of which it is composed must also be of that grade. As, however, no two organizations are governed in their formation by similar conditions, each case presents a problem *sui generis* for the manager to solve, but every case will be found ultimately to consist in a study of human nature in its many phases, and this, we have been told, "is the proper study of mankind."

The attributes which human beings possess in common fall into three classes; viz.: physical, moral and mental. Those belonging to one or another of these classes may predominate in men following different pursuits in life, but in any manufacturing enterprise it is evident that the physical attributes are the most important. No matter how moral or intellectual a man may be, if he is a weakling, if he has not health, he cannot be an efficient part of an active organization. First of all, therefore, the members of the organization must have health, they must be strong and vigorous.

Next he must be of high character, for no matter how healthy or intelligent a man may be, if he is immoral, *i. e.*, if he is dissipated, if his time outside of his working hours is given over to intemperance, gaming, or other forms of vice, his condition physically and mentally while at work cannot be such as to qualify him as an efficient member of a high-grade organization. His physical and mental powers are gradually affected, his sense of responsibility weakens, he becomes irregular in attendance, careless in attention to his duties and cannot be depended upon.

And finally, it is evident that given a man of good physique and strong character, the higher his intelligence and skill in the direction of his duties, the better qualified he will be to accomplish his daily tasks; but it is also evident from the preceding considerations that, important as are these latter qualifications, they must be subordinate to the other two and considered last in relative importance.

Now, I claim that the ordinary system of management in selecting and maintaining an organization, reverses the order in which the value of these qualifications for membership is estimated.

The questions usually asked an applicant for employment are:

First—Have you had a college education?

Second—What has been your practical experience?

Third—Have you ever been discharged? If so, what for?

Fourth—Give a list of people for whom you have worked.

Occasionally—Are you a drinking man?

But the self-estimate of what constitutes a drinking man makes the answer of little worth, and scarcely any interest is aroused by the amount of evasion displayed by the applicant.

MACHINES AND MEN.

Now, although we have seen that the human asset is of greater importance in an industrial enterprise than its mechanical possessions, I think I can safely say that infinitely more pains are taken in obtaining a machine or tool, to see that it is covered by detailed specifications and inspected during construction and before acceptance, than is given to securing the man who will be put in charge of it and held accountable for results from it afterward. Experts from at least one department and frequently from several are consulted, and much time and thought are devoted to the consideration of the machine; and after it has been secured and become a listed possession, considerable care is devoted to lessening its subsequent depreciation, and it is never discarded without protracted debate and calculation. On the other hand, we rarely hear of a recognized labor or employment department in a shop, and when there is one it is seldom intelligently administered. Usually little care is taken in the selection of the men, and no thought is given to their improvement during their time of service. They are taken on and laid off without a thought of consideration for their welfare or convenience, and they frequently live with a sword of Damocles hanging over them, continuously expecting on any pay-day to find their discharge ticket in their envelope. No men can work at their best efficiency under these conditions.

Now, there is one marked difference between machines and the men who operate them which should be noted here. Machines, no matter how well they may be

cared for, depreciate from five to ten per cent, per year owing to the advent of other and improved machines, while men, if they are properly cared for, may appreciate in value several hundred per cent. in the same time. Yet I maintain that as a general rule machines and tools are nurtured, fostered and preserved long after their period of usefulness has expired, while the permanency of service of the men of the organization who operate them receives comparatively no consideration whatever. It cannot be expected that the men of an organization will show any spontaneous enthusiasm for interest in or loyalty to a management that openly displays so little interest in their welfare.

I think these statements are facts, based on the aphorism that the exception proves the rule. For there are exceptions so conspicuous as to make the rank and file of manufacturing concerns in this regard seem commonplace.

I do not, however, wish to find fault with the care which is generally taken in the selection and preservation of equipment, nor do I wish to be considered as casting reflections upon the lack of consideration for the men that has existed in the past.

NEW IDEAS ABOUT THE TREATMENT OF MEN.

Our ideas about the treatment of men by those in authority have undergone a vast change in the past few years. We are, for instance, only now beginning to realize that it pays better to educate our criminals than to keep them in solitary confinement; and our State money is being directed toward making our penal institutions places where the inmates will receive instruction and be surrounded by influences which will make them good citizens after incarceration instead of imposing punishment upon them for the useless object of satisfying revenge, which treatment, having been found to develop resentment, tends to increase rather than diminish the criminal proclivity.

Huxley says: "There are two opposing methods at work in the government of the world, respectively, the ethical and the cosmic. The practice of that which is ethically best involves a course of conduct which in all respects is opposed to that which leads to success in the cosmic struggle for existence. In place of thrusting aside or treading down all opposition, it requires that the individual shall not merely respect but help his fellows. Its influence is therefore directed not so much to the survival of the fittest, but the fitting of as many as possible to survive."

The tendency of the times now is directed away from the cosmic and toward the ethical method of management in industrial and commercial affairs. We are beginning to realize that no success counts which is obtained at the expense of others; that no triumph is a real one which is attained by pulling others down or by keeping them down; in fact, that no life is worth very much which does not consider the welfare of others. The United States Government, for the first time at any industrial exposition, exhibited at St. Louis last year a large number of photographs and pamphlets descriptive of methods of industrial betterment adopted by leading manufacturing concerns in this country, thus showing the present trend of thought in this direction. The United States Bureau of Labor, in its report for 1904, dwells especially on the increase in the number of concerns which have taken this advanced stand. Teachers of political economy in colleges, leading clergymen, lawyers, statesmen everywhere are advocating the adoption of ethical principles in business dealings. President Roosevelt voices this sentiment in his advocacy of giving the other fellow "the square deal," which, after all, is only a modern way of expressing the golden rule which political and social economists all say is the most practical rule of life ever enunciated.

IT PAYS.

The study of cause and effect in the example set by those concerns who have applied these principles has demonstrated that they pay in a financial way. This latter fact comes as a surprise to many, but so also did the fact that model tenement houses pay better in the long run than those of the old type. That establishments who have adopted these methods are continuing to apply them and are extending their application is significant that they are pleased with their results. On these general principles is founded the work which is the function of many industrial and civic betterment associations in this country and abroad. One of these, the Institute of Social Service, established in New York in 1898, collaborates with similar institutions in the principal countries of Europe and in Japan, and keeps on file photographs, drawings, pamphlets and books, illustrating and describing schemes of industrial betterment, plans of industrial villages, improved housing for employees, methods of heating, ventilating and lighting shops, means of preserving health in unwholesome occupations, methods of preventing accidents by machinery and all cognate subjects. The failures as well as the successes are exhibited, as warnings and examples, respectively.

CO-OPERATION MUST BE SECURED.

The National Civic Federation has established local industrial betterment branches about the country, with the object of encouraging manufacturing concerns to adopt the most approved methods of organization and management, in the hope of bringing about a better feeling between employer and employee. An effort in this latter direction must be at the foundation of every individual movement on the part of any manufacturing concern which desires to advance along modern lines. It is only reasonable to suppose that if employer and employee work together for a common end the enterprise will pay better than if each works for his own interest simply, with the full persuasion that the other is trying to get out of him all he can. Co-operation must supplant antagonism to secure a full meed of success. So also of two competing concerns, that one which gains the closest co-operation of its working organization, other things being equal, will have just that much advantage in its race for supremacy. The same law will govern the commercial supremacy of nations.

A FOREIGN OBSERVER.

Alfred Moseley, a rich philanthropist of England, exercised over the threatened commercial supremacy of his country by our industrial advance, brought here in 1902 over twenty labor leaders of different industries to investigate the difference between American and English industrial practice.

His visits were naturally confined to the representative shops in the principal cities, and his report stated that his observations led him to note the superiority of our methods—first, of wage payment, largely by one or another of the merit systems, based on the principle that a certain portion of the factory space was occupied by each workman, that that space represented a certain amount of invested capital, and as the fixed charges on it were the same whether the workman did much or little, the more work he did the better it would be for the company, and if he was paid properly the better it would be for him; second, of encouragement offered to develop the initiative of the workman and to get him to suggest improvements by paying a premium on them; and third, of having the individual workman operate as many machines as he could handle, and when new and more efficient machines come on the market the scrapping of the old ones, although they may be comparatively new.

Mr. Carnegie has coined the happy simile that successful industry is a partnership of Labor, Capital and Brains; like a three-legged stool, the legs of which are of equal strength, no one superior to the other. And Mr. Moseley emphasized the advantage that we obtained in our works by encouraging the workmen to use their brains, and by developing and utilizing the enormous amount of expert knowledge possessed by the workmen, which was not only totally neglected in England, but absolutely suppressed by the attitude of the foremen, who feared that their positions would be in jeopardy if a workman showed that he had any originality.

But Mr. Moseley and his party did not have time to stray very far from the beaten path, and saw principally the large and representative and successful plants.

There are thousands which have not as yet advanced to the state he has described.

A CHANGE TAKING PLACE.

Influenced, however, by the example of the leaders in thought and action, many of the latter have recently experienced a change of sentiment and sought the cooperation of their employees. The change of attitude from one of mutual suspicion to one of mutual respect and confidence is not, however, effected either readily or rapidly. Traditions cannot be destroyed by a simple dictum. Misunderstandings occur in the transfer which delay or offset the proceedings. Some concerns have become discouraged and have discontinued the attempt; others, however, have succeeded and are proud of their achievement. There is a right way to go about it, and there are many wrong ways. Care must be taken that the right kind of people representing the management and the men are selected to accomplish the result.

ADAPTATION.

Alexander Hamilton said, more than a century ago: " A government must be fitted to a nation much as a coat to the individual; and consequently what may be good at Philadelphia may be bad at Paris and ridiculed at St. Petersburg." Similarly a system of shop management which is suited to one industrial enterprise, may work only indifferently in another and be a complete failure in a third. This statement may seem to be trite and unnecessary, but I know from my own experience that as long as men are constituted as they are (and they have probably not changed much since the time of Hamilton) whenever unusual conditions develop in a shop under any form of management, suggestions as to remedies which have been successful elsewhere are at once made by people who are well meaning but have no knowledge of the actual situation. This is empirical, and Charles Francis Adams, of Boston, in a recent paper on industrial conference, says that "in these (industrial) matters, empiracy is of all things to be shunned." What is needed is a careful study by those whose knowledge of the conditions as they exist constitutes them as most competent to analyze the situation and deduce proper methods of procedure.

A STANDING REPRESENTATIVE CONFERENCE COMMITTEE.

In any manufacturing enterprise, a standing committee, on which both employees and management are represented, which meets at stated intervals, is an excellent method of "getting together" those who are competent to act, that each may see the other side of the shield and obtain the other's point of view.

There are frequent occasions arising when the management is anxious to know what attitude the employees would take in case a change in policy is made. On the other hand, the employees, from time to time, wish to lay a request before the management. In either case, some temporary device is usually resorted to to meet the occasion. When a standing committee exists, however, a channel of communication is always open and each side keeps thoroughly in touch with the other on all matters of common interest. An honor system is thereby established among the employees, and the discipline improves greatly. I have never failed to see a marked change come over the entire organization as it rose to its responsibility as soon as the members felt that they were accorded recognition as rational beings and to be consulted on matters of common interest. Generally the rank and file of the working organization is considered in the same category as the privates in an army; they are not supposed to think, but to do as someone above them has planned. The usual result, as might be expected, is that they do not use their brains for the benefit of the concern.

All questions regarding systems of wage payments should come before the standing committee. The introduction of any of the various merit systems can be brought about in a shop with little difficulty if the subject is intelligently discussed by the committee in advance. In this country an appeal to reason is always accorded sympathetic reception, whereas the forcible application of a policy based on general assumptions meets with merited resistance. And I should say here that as all men work primarily for their support the wage question is the one which must be settled first and satisfactorily before any schemes of industrial betterment can be effectively developed. Men work for wages, and will go where they can get the most pay. But of two concerns, each paying the same wage, the one which extends the better treatment to its employees will be favored by the applicants for employment and by judicious methods it can obtain the better class of help.

THE SUGGESTION SYSTEM.

Some work of common interest must be developed to engage the attention of the standing committee and the sub-committees which later may be appointed to handle details. The Suggestion System now so generally adopted by the foremost concerns is a good subject for the committee to handle. This system develops in the operatives the power to observe, improves their capacity of initiative and inspires their ambition. It takes besides the great advantage of being in itself a paying institution, both to the employee and the company, when the latter pays well for valuable suggestions. A recent magazine article over the name of the "Welfare Manager of the National Cash Register Company," which has probably gone into industrial betterment projects deeper than any concern in this country, says that this system will net his company the neat sum of $30,000 this year.

This system may include suggestions from the employees regarding improvements in their own conditions of comfort and work. No one knows better than the workman himself if he is not working under the most comfortable circumstances, but he will naturally hesitate to complain. Yet everyone knows that a man when comfortable can do better work than when he is uncomfortable, and should be given an opportunity to express himself regarding his condition.

The system should also include suggestions regarding improvements in processes and methods of work. The operative, if encouraged to think, will soon effect great savings in the work at which he is more of an expert than anyone else who is not constantly engaged at it. I have recently seen a product considerably redesigned, the process of manufacture simplified and made much cheaper, and the company put upon its feet largely through the introduction of the suggestion system.

MEETINGS OF FOREMEN.

Meetings of the foremen should be held regularly, and instruction given to them in the proper handling and management of men to secure the best efficiency within the limits of fair and just treatment. It must be understood that in order to secure the best quality of work the mind of the worker must be as free as possible from worry about his position. Peace of mind cannot be maintained while conditions exist which entail arbitrary discharge from service or unexpected reduction of wages, nagging by foremen who are affected by favoritism, ineffective facilities for service, unpleasant and unhealthful surroundings, danger of accidents from unguarded machinery, or loss of life in inflammable buildings inadequately supplied with means of escape. On the contrary, credit should be given to each employee for every effort to do his part in advancing the interests of the company. A little encouragement at the right time will do much to arouse ambition and enthusiasm, without which nothing of moment is accomplished.

PRESERVATION OF HEALTH.

I have already shown that health, character and intelligence, in the order named, are the essentials to be sought for in selecting an employee, and, when found, should be fostered and improved. First, then, efforts should be made to raise and maintain at a high grade the standard of health of the organization. Good health means capacity for work, both in efficiency when at work and through increased regularity of attendance. Irregularity in attendance is one of the banes of good management, and it can only be improved by a careful investigation into its causes, and application of the proper remedy. Mutual benefit associations are now quite general, but those where either a doctor or trained nurse is engaged to instruct

the employees how to prevent sickness, as well as to administer prompt and effective treatment during incapacity for work, are effective means of increasing efficiency. Instruction how to live properly, how to cook simple food, how to eat, bathe and sleep, and warnings against the use of patent nostrums will tend to preserve the health of the organization and raise the regularity of attendance. The latter can also be effected by the payment of a bonus annually to those whose presence has met a certain percentage of regularity. A warm lunch will increase the efficiency of the organization during the afternoon and facilities for obtaining it should be offered. Means afforded for exercise and amusement in the open air at noon, especially when the occupation is confining and sedentary, will also have the same effect. The character of the individual should be a no less important consideration in the mind of the employer than his health. It is very necessary to know whether or not the employee can be relied upon in the quality of his workmanship and in his effect upon others in the organization. Some managers say that they are not interested in knowing what their employees do outside of working hours. Some employees say it is none of the manager's business what they do in their own time. When, however, what the employees do in their time affects what they do in their employer's time, then it may be to the latter's interest to look into such matters. What the employer should desire is to have as few changes take place in his organization as possible. Now it should be remembered that in every factory there are apt to be many operatives who, because they are strangers in the locality or from reasons consequent to their condition and circumstances, have no opportunities for social recreation and pleasures, and no places to go to after working hours. Therefore, being more or less creatures of circumstances, they drift into associations and habits which may be debasing in their tendencies. This sort of thing leads to a lowering of the status of the organization through association, if they remain in it, or to an unsettled state if there are many changes due to constant removals. The social instinct in man causes him to seek companionship, and if opportunity is given the members of the organization to attend lectures and other social gatherings which are attractive and at the same time elevating in their tendency, the whole fabric of the organization becomes homogeneous, of high grade and remains intact. And, finally, the education of the employee should receive the attention it deserves. Early opportunity should be seized to improve the mind of the employee as he grows. The wider his knowledge, the better he will perform his duties.

Apprenticeship schools in operation dur-

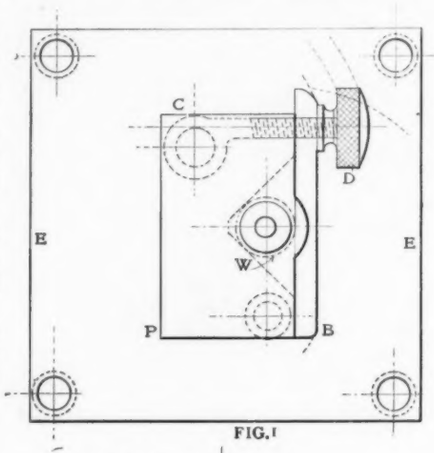

FIG. 1

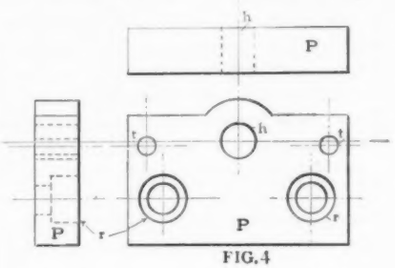

FIG. 4

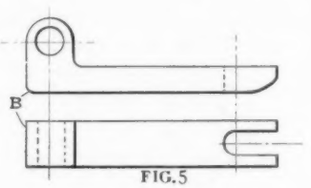

FIG. 5

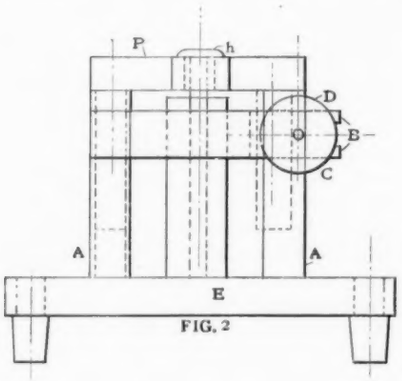

FIG. 2

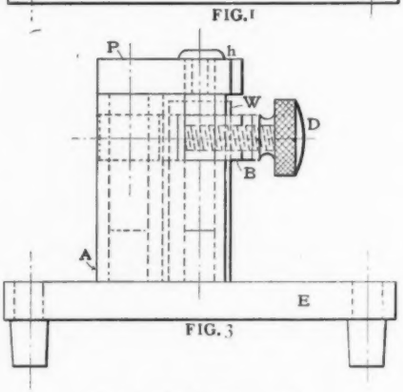

FIG. 3

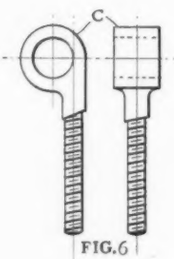

FIG. 6

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TWO V-BLOCK DRILL JIGS.

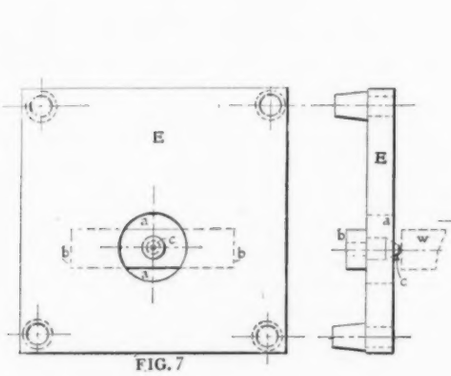

FIG. 7

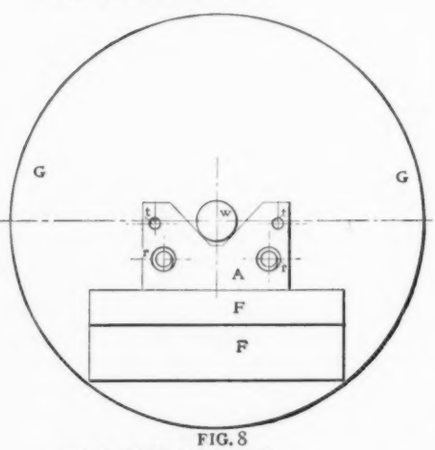

FIG. 8

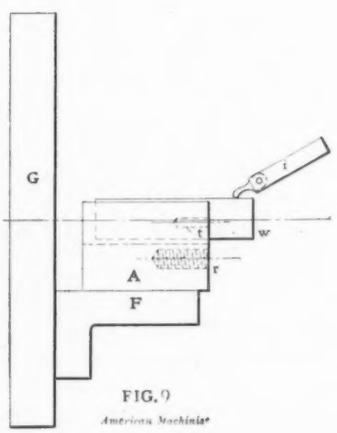

FIG. 9

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TWO V-BLOCK DRILL JIGS.

ing working hours under the charge of a trained teacher, are effective means of developing the mentality of the organization, and at the same time of getting in close touch with the employee early in his career; and the longer he stays with the

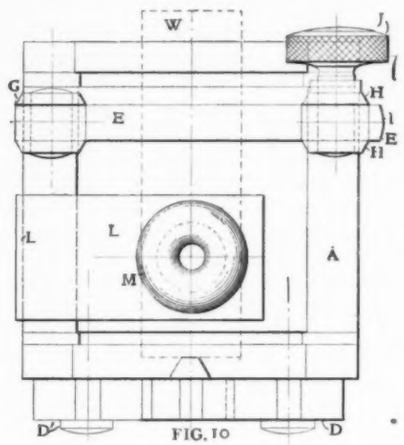

FIG. 10

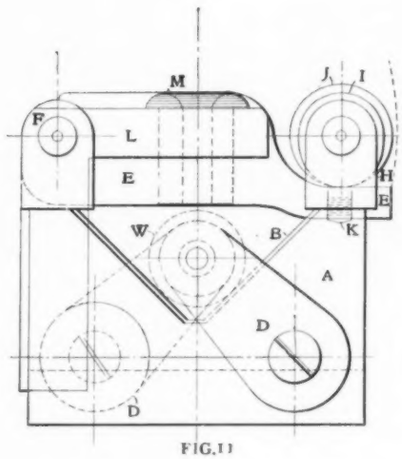

FIG. 11

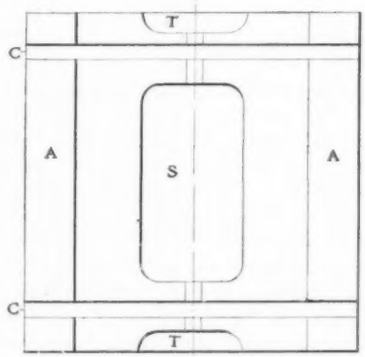

FIG. 12
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TWO V-BLOCK DRILL JIGS.

concern and the more money is spent on his improvement, the more valuable he becomes as an asset and the greater the effort should be made to retain him in the organization. Schools should be established in the factory during evenings, for the purpose of helping the employee to advance in the organization. Energy, coupled with character, and knowledge, guided by tact and discretion, will open the avenues of achievement. Care should be taken, however, not to coddle the organization. Coddling engenders weaklings. Extending opportunities so that the employees can help themselves develops self-reliance, self-respect, and, at the same time, regard for the management. Such a policy promotes a strong and healthy organization. Employees are quick to feel any interest taken in their welfare and as quick to reciprocate. To increase the efficiency of an organization so that each employee is not only a passenger in the enterprise, but effectively pulls his own weight, is the function of this new field of industrial engineering. To do this with the spirit of honesty and fair dealing between employer and employee is a delicate mission. It embraces a wide field of activity in the world of advance, in which industry is the leading exponent. Apart from the practical results obtainable by the foregoing methods of management, lies the fact that it is by instituting only the highest methods that employers are utilizing their privileges as men and citizens to help in the march of mankind in progress and enlightenment.

Two V-Block Drill Jigs.

BY A. B. CHRISTMAN.

In the accompanying sketches are illustrated two V-block jigs for drilling holes in ¼-inch rolled shafting. The method of correctly locating the drill bushings is also described.

The first jig is for drilling a hole in the end of the shaft in line with the axis, and is shown in plan in Fig. 1 and in elevation in Figs. 2 and 3. Fig. 4 is the plate *P*, which carries the bushing, Fig. 5 the clamping lever *B*, Fig. 6 the eye-bolt *C*, and Fig. 7 the foot-plate *E*.

The shaft *W* to be drilled is held in a vertical position against the V-block *A* by the clamping lever *B*, which is locked in place by the eye-bolt *C* and thumb-nut *D*, the whole being mounted on a foot-plate *E* to provide ample bearing surface.

In construction the V-block is first planed true all over and fitted with clamping lever *B*, eye-bolt *C*, and bushing-plate *P*, and mounted on angle-iron *F* on lathe face-plate *G*, Figs. 8 and 9. Shaft *W* is held in position by clamping lever and eye-bolt, and is made to run true with center of lathe by adjusting the angle-iron *F* until indicator *i* shows that *W* runs true. When *W*, *B* and *C* are removed, bushing plate *P* is placed in correct position on *A* by means of its screw and dowel-pin holes *r* and *t*, and bushing hole *h* is bored.

The base-plate *E* has a hole just below and in line with the lower end of *V*, and a machine-steel bar *b* is fixed to cross the hole on the lower side of plate *E*, and carries a hardened pointed pin *c* projecting upward through and slightly beyond plate *E*, and upon this pin rests work *W*; this small bearing point offers no lodging place for chips.

In operation, while the clamping lever *B* and eye-bolts *C* are swung outward and away from *V*, as shown by dotted lines in Fig. 1, the work *W* is inserted with the left hand, and the clamping lever and eye-bolt brought together and tightened with the right hand, a very quick operation.

The second jig shown has a cam- and spring-operated clamping device, which is

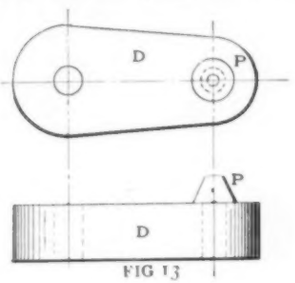

FIG 13

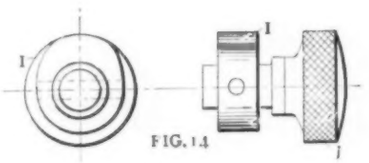

FIG. 14

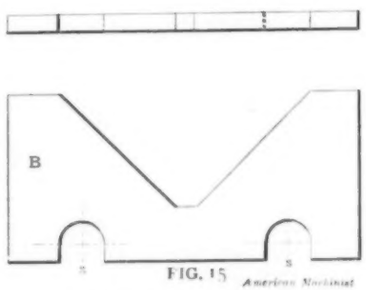

FIG. 15
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TWO V-BLOCK DRILL JIGS.

still quicker than the other, and it has another way of keeping clear of chips. In this case the hole is drilled perpendicular to the axis of the shaft, necessitating a little difference in the process of locating the drill bushing.

Fig. 10 is a plan of the jig, Fig. 11 a side elevation, Figs. 12 to 15 details, and Figs. 16 to 18 show the method of locating the bushing.

Fig. 10 is a plan view of the gray-iron V-block *A*, which forms the body of the jig. *C C* are slots milled at right angles with the V, into which are fitted and doweled two hardened plates *B*, Fig. 15, in such a position that work *W* will rest upon the V-faces of plates *B* and be

clear of the faces of the V in block *A*, as shown at *B* in Fig. 11. The block *A* has the rectangular space *S* and corners *T* cut away so as not to afford lodgment for chips.

D, Figs. 10, 11 and 13, is a plate having a hardened gage-pin *p* as a stop for end of work *W*; it is held in place on the end of block *A* by a screw. As there were two lengths of shafts to be drilled, an extra plate, with a pin *p* of proper length, was provided; also an extra screw hole, as shown at *D'*, for holding it to prevent its loss when the jig is out of use. *E* is a binding lever pivoted at *F* in stud *G* and clamped by cam *I* and thumb-nut *J* in stud *H* and raised by spring *K* when released by cam *I*, as indicated by dotted line *Z*.

In Figs. 16, 17 and 18 are shown a lathe face-plate *N*, angle-iron *O*, work *W*, bushing bracket *L* and indicator *i*. By adjusting the angle-iron *O*, the shaft *W* is made to run true to indicator *i*, Fig. 17, then it is turned around and squared with face-plate *N* and hole *h* is bored.

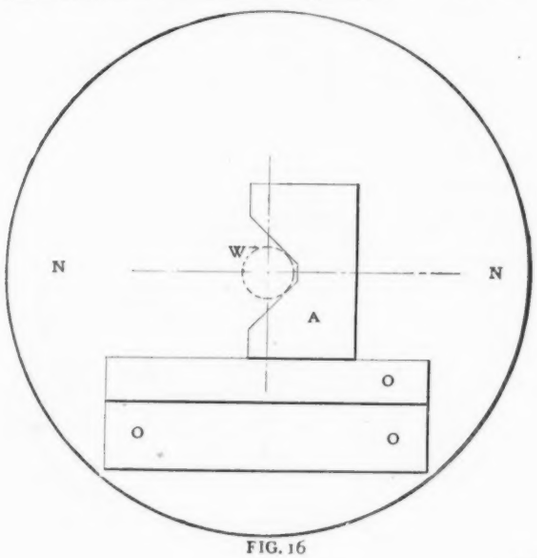


FIG. 16

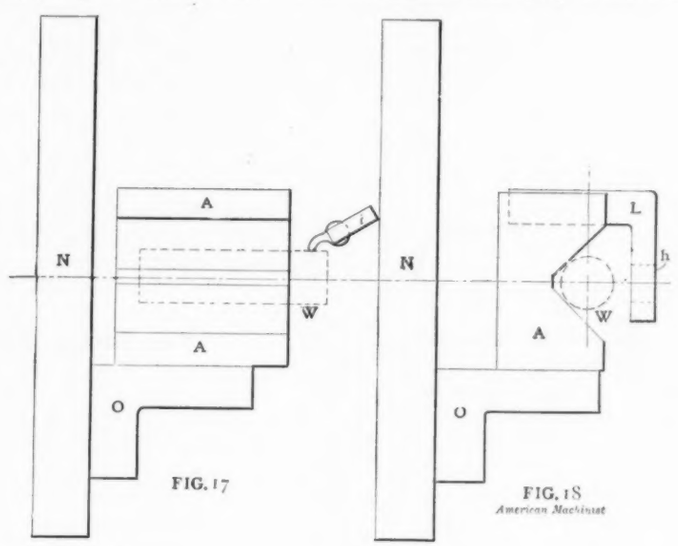


FIG. 17

FIG. 18
American Machinist

TWO V-BLOCK DRILL JIGS.

The operation of this jig is extremely simple; a quarter turn of thumb-nut *J* and cam *I* allows spring *K* to raise binding lever *E* for removal of work *W* and the same movement reversed clamps the new piece; moreover, very little care is required to keep the five bearing points, upon which the work rests, free from chips.

I have omitted the jig-feet and some of the lines, and have distorted the proportions somewhat to more clearly convey the idea.

The eighteen-hour train of the Pennsylvania Railroad between New York and Chicago has arrived at Chicago behind time only four times since the train was put on. The greatest delay was 13 minutes, which occurred by the train being held from entering the station by an accident to another train, a half-mile out. On three other occasions the train was late from two to nine minutes.

Echoes From the Oil Country—Cliques in a Shop.

Sammy was green as could well be for a young man of average intelligence. Unless you know something about the way he had been raised, you might doubt whether or not he had average intelligence if you should discover how remarkably green he was in some directions. Space is too short to give an insight, at present, into the peculiar combination of events which tended to make him the Sammy we find at this time. I can only say that there had been rather too much theory in his raising, and as yet his "practical" experience of life had not been extensive enough to enable him to know how far away from the ideal things really are.

It was the following of "ideas" which had been taught to him and of which he formed his own conception as to how they should be worked out, that made him seem at times odd.

When Sammy got a job at this place he was not much more than a boy. He had not been much more than four years at the trade, and he still believed it to be his duty to work for the interests of his employer and to fit himself for any work that might come in. One of his weak points was his ignorance of human nature; that is, of the kind of human nature that had come up under entirely different conditions from what he had. He had never "got the worst of it," for reasons that were entirely removed from any act of his own, and he still believed that if he did his duty toward others they would do theirs toward him. Life was still comparatively simple to him, for he had not as yet become aware of the multitudes of strings that are attached to us all. He had never been "up against" a string of another man's interests which was so strong that it stopped all progress on his part, and that without the least unfriendly feeling toward him personally on the part of the man who had the opposing string, maybe.

One day a fun-loving "kid" in the shop was making life more endurable for himself by dropping chips on one of the men. Finally the man caught him at it.

"You confounded little limb of Satan, if you don't stop that I'll come over there and knock the stuffing out of you."

"Did one of them chips hit you?" asked the boy, with a great show of surprise.

"If another one hits me I will show you whether it did or not," said the man, with an angry scowl, as he turned again to his work.

Sammy had seen part of the performance, and when a chip from the boy's chisel hit him on the neck he knew where it came from, and looking up he saw that the boy was industriously chipping in his direction.

"Here, boy, I haven't any use for your chips. Send them some other way," said he, with a laugh and a shake of his head at the boy.

The boy grinned in a friendly way and shifted his position. As Sammy and the other man were the only ones within range of his chisel, he soon began to get the range of the other fellow again. Chipping was evidently easier to him if the chips hit someone.

Sammy was keeping an eye on the boy, so as to see that he did not again become the target, and as he saw where the chips were going he began to wonder what the man would do. He was not kept long in doubt, for after an extra large chip had landed safely on the back of his neck, the man turned, and without as much as glancing at the boy, came directly up to Sammy. He was a big, raw-boned fellow, and the look on his face was far from being a pleasant one.

"Curse you!" he hissed through his

clenched teeth; "for two cents I would smash you down right here, and grind you into the floor."

"Why, what in the world have I done to you?" gasped Sammy, in astonishment.

"What have you been doing ever since you came to work here?" asked the other, with a sneer. "And now you put the boy up to dirty work."

Sammy did his best to explain that he had not in any way influenced the boy, except to get him to stop letting the chips fall on him, but that the boy had all other points of the compass to chip toward had he felt so inclined.

The man in his rage had evidently gotten facts, fears and fancies all mixed up, for he burst in with: "What's the use of you talking. Didn't I hear you tell the boy to chip at me?"

Sammy could hardly believe his ears. "You didn't hear me say any such thing. You couldn't have, for I didn't say it."

"Do you mean to call me a liar?" shouted the man, waving his arms in a threatening manner.

"I mean to say that if you say you heard me tell the boy any such thing you are saying what is not true, and you may take it any way you like." Sammy had lost his temper also.

"Foreman's coming!" called someone, and with a muttered curse and a threat the man went back to his place.

It was surprising how many men had business over near Sammy or the other man before the day was over. Sammy did not know what sort of talk was going on at the other place, but he knew that he received all sorts of advice as to how he could best reduce the other fellow to the depths of woe, and he also learned much of the evil history of the other from his birth down, as well as the history of his various and varied family connections. (He never received any confirmatory evidence to back up the most of these statements, and so soon afterward doubted most of them.)

That evening it seemed best to Sammy to be extremely slow in cleaning up, and before he was ready to go everybody else had gone, except the engineer and the other man. After a few preliminaries there was a rapid exchange of compliments, in which fists took the place of words, and at the end of these it was found that Sammy had enough the best of it so that the other fellow expressed himself as willing to let the matter drop.

Some inquiries by Sammy developed the fact that the shop was split up into cliques, and that one of these cliques had used the fact of Sammy having come to work to worry the other fellow. They were both doing erecting work, and each had to do his own bench and vise work. Sammy had done his work as best he knew how, without regard to the other man or his methods, and by the clique every variation was noted and commented on, to the disparagement of the old hand, without regard as to whether the way was better or worse. Along with this were various things that it was reported to him that Sammy had said, until he really believed that Sammy had been brought there for the express purpose of running him out of his job.

After getting started once it did not take Sammy very long to figure out how things stood in the shop. There were three factions or cliques, and every man who was counted as amounting to anything was in one or the other of them. Some of the men were so bitter that they would not speak to the members of either of the other cliques, no matter how much the work suffered by their actions. Others did not carry matters so far, but were content with badgering; but in any case every opportunity was made use of to make life miserable for those of the opposing factions.

The blacksmith was a man of more than ordinary education and breadth of mind. He had good common sense, and did not take sides anywhere. As he did not belong to the shop, and had to do tool-dressing for them all, it so happened that he was well posted as to what was going on without having to take sides.

The day after the fight he took time to have quite a talk with Sammy, and showed him that there was at least one man in the shop who was willing to be friendly regardless of any clique. If it had not been for his influence it is likely that Sammy would either have been drawn into one or other of the cliques or else thrown up his job in disgust. As it was, he made up his mind that he would stay out of all of them, even if he had to be without friends to do it.

It was not long before he began to occupy a peculiar position in the shop. At first it often happened that someone would come and begin to tell him of the shortcomings of one of the other factions or of some member of it. Finding that the tale did not find a willing listener, or perhaps even that the absent, abused party was given credit for some good points, a suspicion would be aroused, and sometimes expressed, that Sammy had thrown in his lot with that party. Gradually it was generally learned that he did not have anything to say *about* anyone that was detrimental, and at the same time there was another thing that was learned, and that was that he was not at all slow in expressing an unfavorable opinion of a person *to* that person.

It was not a rare occurrence for someone to come intending to tell something to the discredit of another, and to go away with a very vivid description of his own shortcomings as portrayed by Sammy. If Sammy noticed that there were men who did not seem to like him he did not let it be known, but went wherever his work took him, and treated everybody as though sure of a welcome.

"See here, Fatty, I've been working all morning trying to get these guides to look decent. If I was you I wouldn't say anything about the fellow that got the crank disk a little bit tight after doing a job like that. I know that my file scratches are pretty deep, but they are not nearly deep enough to get under these chatters of yours. Most of your work is fine, and that is why I am kicking now. I wouldn't kick a bit if I thought this was the best you can do, but I know better."

Sammy's place is over near the pump and Fatty has the drink that he comes after, and with the best crack he could land back he goes back to his machine across on the other side. Perhaps he hurried a little for he did not care to meet Charley, for Charley belonged to a detested crowd.

"What was that big skinful of putrid filth trying to give you?" was Charley's greeting.

Sammy may have been too busy to hear what was said for he looked up cheerfully with, "Hello, Charley; I was just wishing that you would come along. What got wrong with you when you were finishing that crankshaft. I wouldn't think it was yours if I didn't know it."

"If any of them old mossbacks think that they can come over here and pick my work to pieces they will find out a thing or two the first thing they know," and Charley looked around the shop as though he was picking out the particular victim that he intended to start in on. Charley, be it remembered, was in some way related to some members of the firm and therefore a person of importance. He was a leader of one of the cliques.

"I did get a hard story about you on this shaft business, and if I were you I would fix the fellow that told it. Here he is." Sammy pointed to the shaft, the finish of which was not as good as he thought it might have been.

"Wa'n't that fellow beefing about me or my work?" Charley asked in a somewhat milder tone, but with some suspicion.

"Don't you get excited for fear of any one saying something about your work. The work that comes over for me to fit up tells me a lot more mean things about the lot of you than I want to hear. I believe all it says, and I don't care a snap what the rest of you have to say."

"I might have put a little nicer finish on that shaft, but you will find her as true as a die." He was not so belligerent when he found that the shaft w. , the accusing party. "It's a mighty sight better than it would have been if George had done it. He did the one for the last engine. Look at the finish he put on the cylinder."

Sammy may have been thinking about something else, for Charley's concluding

remark did not seem to penetrate his understanding enough to bring forth a reply, at least not a direct one.

"Charley, if I had an enemy and wanted him to be as miserable as it is possible for a man to be, do you know the shape I would want to get him into?"

"No, but I'd like to." Charley seemed real interested.

"I would just want him to work here in this shop, and to get so suspicious that every time one of the other men looked at him he would think it meant mischief, and every time he saw two men talking together he would think they were plotting against him, and every remark he heard he would be looking for some mean hidden meaning. I don't think that 'Old Horny' himself could improve much on the job."

"Wait till you have worked around here as long as I have and you will know some fellows better than you do now."

"Only for one thing and I would say that it was quite a decent lot of fellows who work here. If I really thought that the lot of you were one-half as bad as you try to make out one another to be I would quit at once and be glad to get away with my tools, and if I was the foreman for awhile I would make some of you act differently toward one another or I would have a house cleaning. A good spanking is what should be applied."

It is hard to tell how much such a condition hurt the shop, but there was a time when Sammy was the only man in the shop who would speak to every one in it, and he was the only man that every man would speak to.

He had to keep watch to see that work that he needed was not hung up because of personal dislikes among the men. A man would get his part of the work done on a piece but would not deliver it to the next man, and that man would not go after it. Sammy would act as go-between and bless (?) both of them. It would be found that two parts that should would not go together, and each man would declare that it was the fault of the other man and refuse to change his part of it.

There was no doubt about the foreman knowing all about how affairs stood, and it even seemed to Sammy at times as if he rather liked to have it so. There were advantages that came from it. The foreman could go away and be gone for days and the work would go right along. Every man knew that if he did anything out of the way there were others there who would be glad to see that it came to the ears of the foreman when he did return. Each one tried to do his work well, for each one knew that there were watchful and unfriendly eyes looking for defects to remark about.

To offset these advantages was the lack of the friendly helpfulness that so often makes the work a little easier.

Work began to crowd to such an extent that a night gang was started and Sammy was put in charge. Only part of the tools were operated, and the men had to do their own helping. This gave Sammy a good chance to see that the men got acquainted and were civil to one another. Some of the gang were new men, and some of them were taken from the day force, but regardless of their feelings toward one another, each man was given to understand that he must deliver his work to the next man. They also had to help one another. It took a little time to see just who could help another with the least loss of time, and where it did not naturally work out itself Sammy decided. If he found a man trying to change his work alone when he should have had help, he investigated at once and someone got into trouble. If the man did not call for help the trouble was his, and if he did call and the man called did not come, he was pretty apt to think it was better to come the next time. It was not a very big shop and was being worked nights in the one room only, so that it was not hard to see most of what was going on.

Sammy expected to have trouble when he started in, and thought that he would lose some of his men, or at least have them go back on to the day gang they had come from. One of the ringleaders of one of the factions, who for some reason had asked to be put on nights, did "fly off the handle" one night and take his tools and leave; but after thinking it over a few days, he came back and apologized and asked to be allowed to go to work again. He was the only man who quit because of any factional feeling.

Sammy had to have some plain talks with some of the day men who ran machines that were also run nights, and gave them to understand that small tools and fixtures must not be hidden or left out of order, nor partly finished work left in the machine without the man who was to go on with it receiving the necessary directions.

"I don't care a cent what you think of him or what he thinks of you, but I do care how this work comes out. If my man goes off in the morning without posting you about the work he is leaving and I find it out, I will 'fire' him; and if you go off and don't post my man, I will see the superintendent about it and do my best to have him throw you out. Maybe the man who will not do the work he is paid for doing would not steal, but he would come mighty near it," was his way of putting it.

After the work had been going on for several months, Sammy got a better job in a distant city, and another man was put into his place. In less than two weeks things were in such shape that the night gang went on strike and the night work was discontinued.

Judging from a notice that has just been given to me by a friend who has been traveling around, someone very much like Sammy has been tackling the same problem in the blacksmith shop of a large corporation.

Leaving out the name of the corporation, the location and the names of the foreman and his assistant, it reads as follows:

—NOTICE—

To every man employed in this Blacksmith Shop.

Every man shall attend strictly to his own business; the peculiarities of other men are no affair of yours.

Tattlers, or those repeating what others have said concerning another employee, and thus causing dissension in the shop, will be dismissed at once.

Anyone who may be dissatisfied with his position or with the men with whom he has to work, will be accommodated with his money upon asking for it, or sooner if the fact becomes known to the foreman.

The men in this shop are all made of the same kind of clay. We have neither Irish, Germans, Dutch, Hungarian, Italians, Hunkeys or Americans. Every man is an employee—nothing more and nothing less. (This includes the foreman.) It does not matter in what country the employee was born; if his work is satisfactory, and he is a clean, respectable man, who attends to his own business, not letting his imagination run away with his common sense (if he has any), he has as much right to his position in this shop as the foreman has to his.

Any man who ridicules another man's religion has no religion himself, and is a fool.

There is not a son-of-a-b—— in this shop, and anyone calling another such will be dismissed for lying.

If you wish to keep out of trouble, tell the one who wants to tell you something "on the quiet" that you do not care to hear it. If we attend to our own business alone we will have no time for the stories of others.

When I am off duty at any time, Mr. .....'s word shall be as mine.

(Signed) .....

Foreman.

The necessity for such a notice would seem to indicate that there were castes and rings that, for the good of the shop, needed to be broken up.

I am sorry that such things are not always confined to the poorest class of employees. Rumor has it that it sometimes involves the heads of departments and others in high places. With that kind of an example the men can hardly be blamed for doing likewise, but it may not increase the dividends, and investors like dividends.

W. Osborne.

It is announced that the Pennsylvania Railroad Company has decided to equip the old West Jersey & Seashore Railroad from Philadelphia with electric power.

Studies in Inventive Problems—XII.

Proposed by Leicester Allen and Solved by Various Readers.

Some solutions of Problem IV remain to be presented. Space would not permit their presentation in the previous article of the series.

PROBLEM IV, SOLUTION NO. 9, FIGS. 1, 1*a*, 1*b* AND 1*c*. F. W. BACH, ILION, N. Y.

"I use the shuttle-block idea. The plan is shown in Fig. 1. Fig. 1*a* is a section on line *x x* in Fig. 1. The crank *E* turns in direction of the arrow. The connecting rod *D* has drawn the sliding block *A* by the aid of the stem or pin *C* along the guideway *M* and has entered the shuttle block *B*. Any further movement will carry the shuttle block along the guideway *N* and the angle *O* will act as a cam on the roll *K*, which is held in the latch by pin *L* and will cause the latch *F* to slide into a notch in rear of the sliding block *A*, the roll following along the straight or vertical side of the guideway *N* to the end and return, when the latch *F* holds the sliding block and shuttle block together back to the beginning of *N*, where the roll *K* strikes the angle *P* on the piece *G*, which draws the latch *F* away, allowing the slide block *A* to leave the shuttle block *B* just as they come to the end of the way *N*, and then continues along the way *M* to the end, and so on as before. The piece *G* is made adjustable by the taper screws *H*, and the angle *O* may also be made adjustable. Figs. 1*b* and 1*c* show details assembled in Fig. 1."

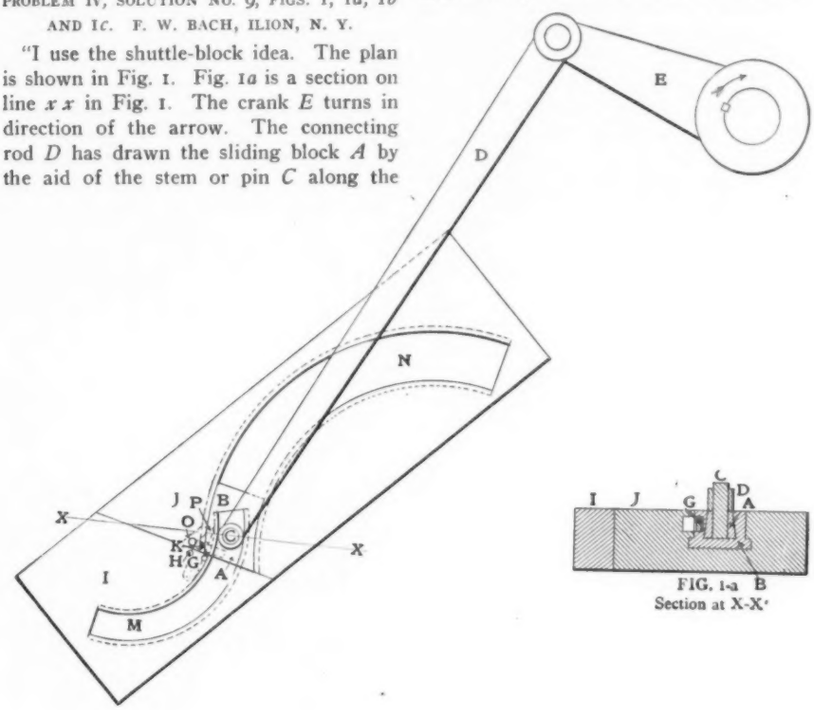
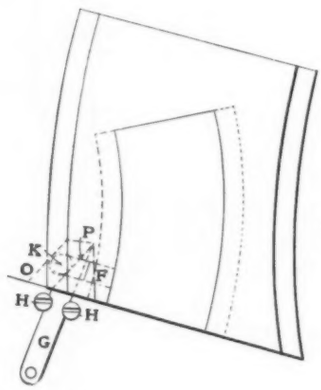


FIG. 1-a
Section at X-X'



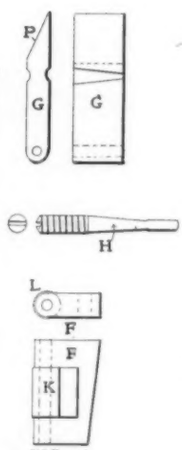


FIG. 1-b
Enlarged Details of Shuttle Block and Locking Mechanism

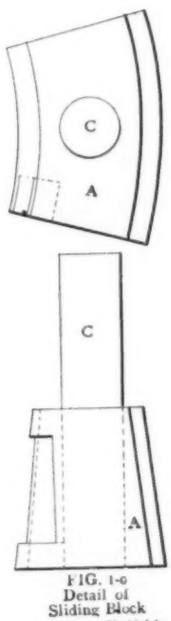


FIG. 1-c
Detail of Sliding Block
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Solution No. 9 of Problem IV.

PROBLEM IV, SOLUTION NO. 10, FIG. 2. LEICESTER ALLEN, NEW YORK, N. Y.

The guides are shown at *g* and *g'*. The sliding block *h* carries the cutter spindle *p*. The sliding block *h* fits into a recess in the shuttle block *d*, both the sliding block and the recess having the same curvature as the branch *E'* of the way *E E'*. The branch *E* of the way has about twice the width and depth of the branch *E'*. The axis *b* of the spindle traverses the prescribed path *a b c*. The dot-and-dash line *a b c* indicates the direction of the drive at beginning and end of the travel. The guides *g g* are bolted to the table *T*. To the sliding block *h* is bolted a laterally extending arm *s*, carrying at its outer extremity a wheel *r* pivoted to arm *s* at *p'*. The periphery of the wheel *r* comes in contact with the outer surface of the upper guide *g* at the instant the axis *b* of the spindle *p* coincides with the line *f f'*, which passes through the junction of the two branches of the path. At the instant the axis of the spindle reaches the line *f f'* the sliding block *h* is locked in the shuttle slide *d* by the action of the arm *s* and wheel *r*, because the block *h* can only free itself from the recess in *d* by moving around two different centers, to wit, the center *f* of the shorter branch of the path, and the center *p'* of wheel *r*, which is impossible. The block *h*, after the axis *b* passes the line *f f'*, remains locked during its travel over the branch *E* of the way in both directions, and on its return is unlocked on reaching the same position. My solution of the problem shown to one of the editors of the AMERICAN MACHINIST before receiving any solutions, was that shown by Mr. Ulmann in his Fig. 4, in his last article of this series, issue of November 2, 1905.

Since the foregoing matter was prepared for the press, I have received the following additional solution to Problem III. This solution is contained in a communication from Carroll Ashley, of Rochester, N. Y. It will probably be remembered that Mr. Ashley contributed a solution in article X of this series at page 319, stating that the solution proper was the work of L. D. Castor, general superintendent of the Eastman Kodak Company, Mr. Ashley's part being the drawing and description.

PROBLEM III, SOLUTION NO. 11, FIGS. 3 AND 3*a*. L. D. CASTOR, ROCHESTER, N. Y. DESCRIBED BY CARROLL ASHLEY, ROCHESTER, N. Y.

"Since sending you the solution to Problem III, which was published in the AMERICAN MACHINIST of September 7, Mr. Castor has devised a much simpler

mechanism attaining the same result, which not only prevents the tilting of the block, but effects a uniform movement from corner to corner, and which I think is worthy of consideration before this problem is dropped. Some of the movements heretofore published, where the block *E* is driven by a crank or other means operating from the center, will drive the block faster as it approaches the corners, or the maximum throw from the center, than at the sides. Mr. Castor has remedied this defect by using a chain as the prime factor for driving the block *E*. A careful study of the drawing will demonstrate: That a chain of an equal number of links, traveling in the track *F*, would not turn the corners without an expansion and contraction of the chain; hence the use of a chain with an odd number of links. It would be possible to attach a block like *E* to every other link, as far as driving blocks like *E* are concerned; but to belt up and drive, say eight separate tools, each working as a separate unit, would require some further thought. Still, I think one, two or four distinct tools could be driven to advantage on some work. In the drawing, the block *E* is shown in two positions in the plan view. In the outside pieces *C* is milled a track *F*. The base *A* has also milled in it a slot of exactly the same width as that of the track in *C*, and in perfect alinement with it. This track not only acts as a guide to the rollers on the chain, but also guides the piece *J*, hereinafter called the driving link. A reference to the drawing will show that the outside edge of track *F* must bear against the driving link, else the driving link would have a tendency to cant. At each corner in pieces *C* an opening, shown at the dotted line *L*, is milled. This opening is just wide enough to permit the driving link to swing around as the chain carries it past the corner. This driving link, bearing against the surface of *L*, with the stud *G* traveling in track *F*, practically locks *E* in the corner until *J* enters the straight part of the track *F*. Now, to properly explain the functions of this driving link, I will describe the chain and its driver. In the upper and lower openings of the track *F* are fitted rollers which rotate on the studs of the chain, these studs being held equidistant by the links. This chain is driven by a four-toothed sprocket *H*, situated at one corner of the track *W*. A clear view of its location is seen in the cross-section made on line *x x'*. This sprocket is so constructed that there is no lost motion in the chain from the time one tooth enters a link until its release, for as one tooth starts to release a link the next tooth has caught another link. On the driving link hinges the successful prevention of the tilting of the block. It is, indeed, the king-pin of the whole mechanism. At either end of this driving link is a slot *I*. This link does not take the place of the regular links, but it occupies a space provided for it directly above and resting against one of the other links, as shown in cross-section. Through the slot *I* run two of the regular studs of the chain. The two rollers that ride above in track *F* are shorter than the others by the thickness of the driving link. Equidistant between the slots *I I* is placed another stud *G* and a roller. This stud only runs through the driving link, and the roller works only in the upper part of the track *F*. While the driving link is turning the corner the roller on stud *G*, following the upper part of the track *F* and the corners of the driving link bearing against *L*, make a positive dwell of the block *E*, making an effectual lock until the stud *G* has traversed the entire curved portion or arc of the track *F*. Now, opposite stud *G* and central in block *E* is another stud *K*, having a positive fit in *E* and a slip fit in *J*. As the driving link *J* aproaches a corner the two studs connecting *J* to the chain give it a positive drive. Just at the precise moment that *E* reaches a corner, it dwells (the stud *G* practically locking *E* at this point of travel) until the stud *G* in the driving link has passed the rounded part of the track *F*. The links, studs and rollers could be hardened together with the driving link, and the block *E* could be driven as fast as desired. A suitable pulley attached to shaft *M* drives this device substantially as described."

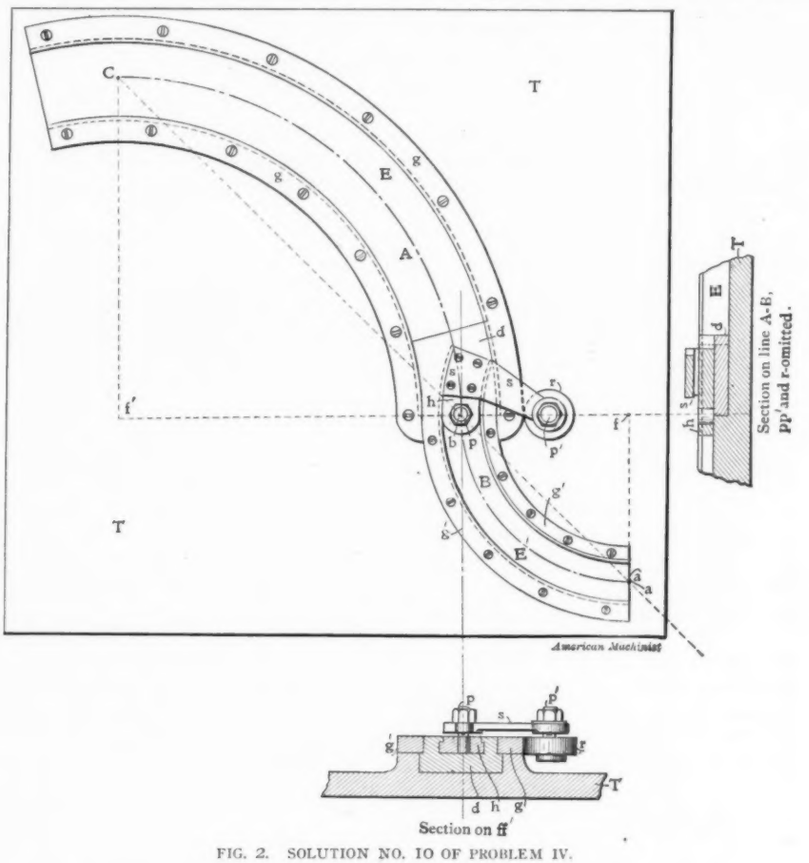


FIG. 2. SOLUTION NO. 10 OF PROBLEM IV.

Uniformity of motion over each branch of the path, which seems to be the thing principally sought in Mr. Castor's solution, as described by Mr. Ashley, would be desirable for some purposes if the motion of the block were required to be rapid. The use of chain drives has of late years extended to many new applications. But such drives have their disadvantages. The link pivots wear pretty uniformly if made of homogeneous metal, and the wear of each multiplied by the total number soon accumulates a total amount of wear that produces slackness unless means be provided for taking up the slack as fast as it accumulates to a detrimental degree. The faster the speed under uniform resistance for all speeds, the sooner will the slack accumulate. I can see no good practical way of overcoming this objection in Mr. Castor's solution, and I should expect it would give trouble. The tilting of the block, however, seems to be provided against efficiently.

PROBLEM IV, SOLUTION NO. 11, FIGS. 4 AND 4*a*. A. W. CHAPPELL, NEW YORK CITY.

Mr. Chappell contributes a very neat sketch, and a clear description of a solution quite different from others which have been published, or which yet await publication. His description follows:

"Movement of the cutter spindle 1, Figs. 4 and 4*a*, in a path whose center line describes a *cyma recta*, is guided by the concentric slot in stationary member 11 and controlled by linkage 13 and 14. Motion

along the chords of the curves is made by the reciprocation of the yoke member 4 by crank 5 keyed to vertical drive shaft. The crank-pin 6 rises through yoke 4 into rim of internal gear 7.

"Inside the gear wheel is the linkage; and the member 13 is centrally pivoted thereto. The outer end of 13 is pivoted on shaft 9, which bears link 14 and gear 12 and slides in a slot in member 11 and block 2 to move in the arc of 90 degrees and return by 240 degrees turn of the crank-shaft. The path of the smallest curve is controlled by link 14, together with link 13 guided by shaft 9 in the concentric slot in member 11. The important function of the linkage 13 and 14 is exercised at the moment of return at the lower end of the small curve in reducing the prohibitive angle of thrust of block 2,

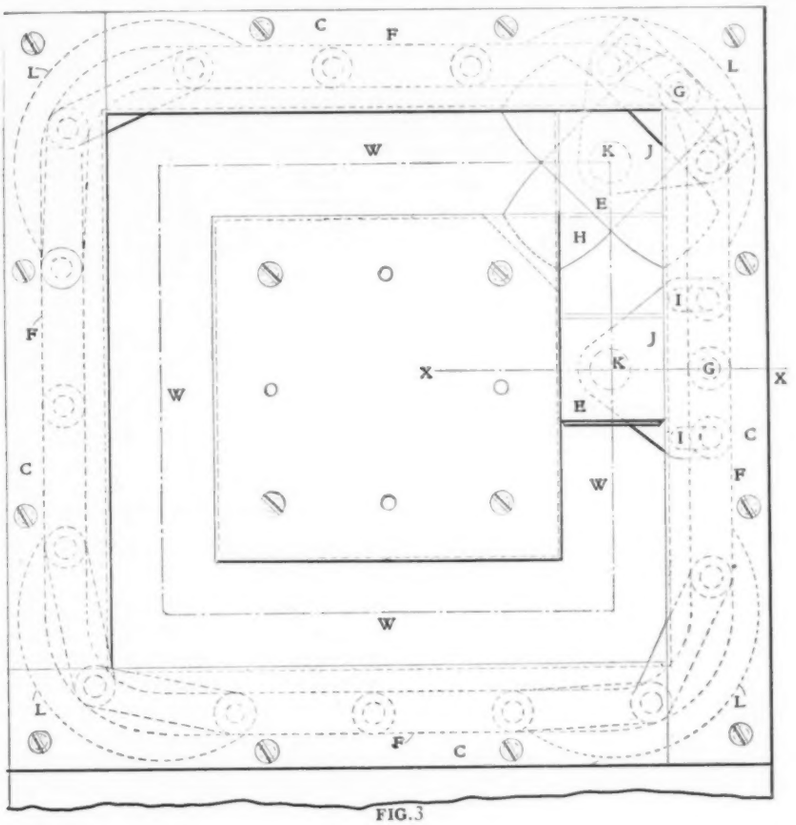


FIG. 3

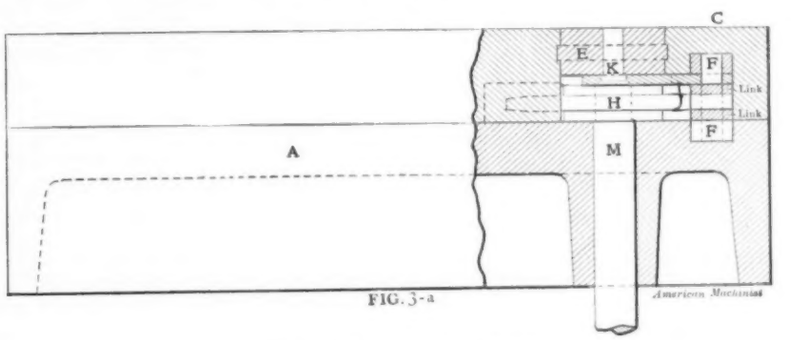


FIG. 3-a

SOLUTION NO. 11 OF PROBLEM III.

is held vertical by a key in gear 10. The other end of link 14 pivots on the cutter spindle 1, which is supported in sliding block 2 and has gear 16 keyed thereon. Block 2 slides in yoke member 4, which reaches down to and slides on guideways 15, having a slot in the lower member engaging crank-pin 6. Internal gear 7 has its bearing in plate 8. Rotation of the driving shaft reciprocates the yoke 4 and drives gear 7. Starting from the position shown in Fig. 4, the link 14 causes the if dependent on shape of ways in table 3, for guidance at this point; however, link 14 transfers the direction to the line of the tangent of the arc described by the axis of shaft 9, carried by link 13. Should the stock be fed along in the direction *A—B* at the speed of 70 units, while the yoke *A* moves at rate of 99 units, the result would be the formation of a series of connected semi-circular curves, large above line *A—B* and half the size below, *cyma recta* rights and lefts."

PROBLEM IV, SOLUTION NO. 12, FIGS. 5, 5*a* AND 5*b*. C. W. PITMAN, PHILADELPHIA, PA.

This is a simple solution, but there appears one objection to it, to wit, the cylindrical upper part of the block sliding in the groove *a b c*. As this part bears against the ways its wearing surfaces are so small that a perceptible departure from the required path will become apparent after a short term of active use. I have never been able to secure great accuracy in the movement of a pin working in a slot, except at the beginning. Mr. Pitman's description is as follows:

"The groove *a b c* in the table *T* is the required path of the cutter-carrying block *A*, the upper part of which is of cylindrical form, fitting the groove, while the lower part slides freely in the cross-slide *B*; this cross-slide is reciprocated in the main slide *C* by means of the pulley *P*, crank *D* and connecting rod *E*. Block *A* is thus compelled to traverse the slot in the table, the cross-slide *B* allowing the necessary side movement due to the varied distances between the center lines of slide *C* and groove *a b c*. Slide *C* is secured to table *T* by bolts and brackets, not shown."

PROBLEM IV, SOLUTION NO 13. DESIGNED BY L. D. CASTOR, ROCHESTER, N. Y. DRAWING AND DESCRIPTION BY CARROLL ASHLEY, ROCHESTER, N. Y.

Examination of the drawing and description of this solution shows it to be substantially equivalent to that of Mr. Pitman, No. 12, presented above, with the exception that Mr. Castor provides a roller to run in the *cyma recta* slot. He uses the crosshead for permitting lateral movement of the sliding block. In the description is the statement that "by the adoption of this method the sliding block may be moved in other curves than the *cyma recta*, provided the radii of the curves have not too small radii." No intimation that this extension of the problem is possible has been perceived by others or has been expressed in any other solution.

PROBLEM IV, SOLUTION NO. 14, FIGS. 6 AND 6*a*. DESIGNED BY L. D. CASTOR, ROCHESTER, N. Y. DESCRIPTION AND DRAWING BY CARROLL ASHLEY, ROCHESTER, N. Y.

"The connecting rod is directly connected to the block *E*, which latter is of unusual construction because of the nature of the path it has to travel. The side of block *E* marked *L*, together with the projecting gib, is machined rounding to conform with the larger curve *N* of the *cyma recta*. On the opposite side at *M* it has another projecting gib of the same size, but this side is machined to fit the smaller curve *O*, on the bottom, as shown in the cross-section *X-X'*, Fig. 6*a*. The block *E* is milled away, leaving two lugs *R'* and *R''*. These lugs are formed to the same radii as *L* and *M*, respectively. The lug *R'* guides the block *E* and keeps it from tilting while traversing the large curve, and *R''* does the same for the small curve. An inspection of the plan view, Fig. 6, will

reveal a tongue marked *S*, located in the path of the *cyma recta*, first on one side, then the other. It should be understood that this tongue is part of the base *K*, the clearance openings *T T*, and the slots or paths for guiding *R'* and *R"* being milled away. Now, when the block *E* starts on its travel, it is retained primarily in the path of the *cyma recta*, by the projections or gibs on its sides, but it depends on the lug *R'* to guide it through the large curve *N* and on *R"*, through the small curve *O*. Suppose we start the block *E* on the long curve first; just at the precise moment that the rear of the lug *R'* leaves its track at the point marked *P*, the lug *R"* starts to enter its track on the curve *O*. As *E* advances and swings around to this small curve, the point marked *P* follows and bears against the tongue *S* at *U*; this gives the lug *R"* an opportunity to get fairly started into the curve *O* and at the same time it will be supported just where it would have a tendency to cant. In other words, there is no time in the turning from curve *N* to curve *O*, that the block *E* has a chance to tilt, or is left unsupported. In the return motion of block *E*, from curve *O* to curve *N*, the same movement takes place, only reversed. When *R"* reaches the point *Q*, this point bears against the tongue *S*, at *V*, until the lug *R'* has entered its proper path. Although the driving of the block *E* is shown as from a crank and pitman, a vertical motion could be obtained by driving direct from a crosshead, the crosshead in turn being connected to a crank and disk. Several of the movements described heretofore, as well as the two I have just described, could be driven by a bell-crank motion."

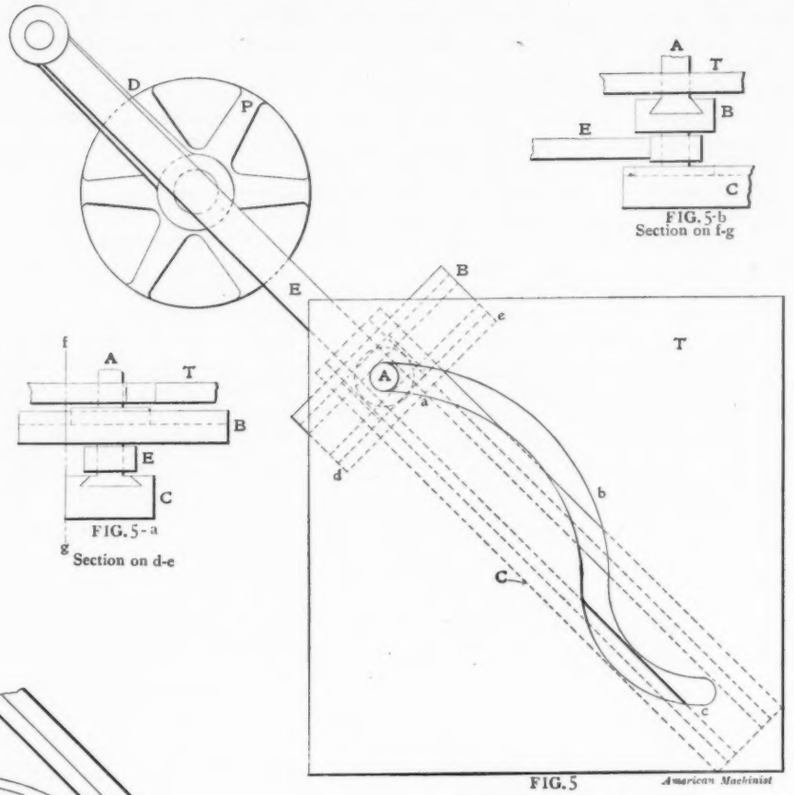


FIG. 5-b
Section on f-g

FIG. 5-a

FIG. 5

SOLUTION NO. 12 OF PROBLEM IV.

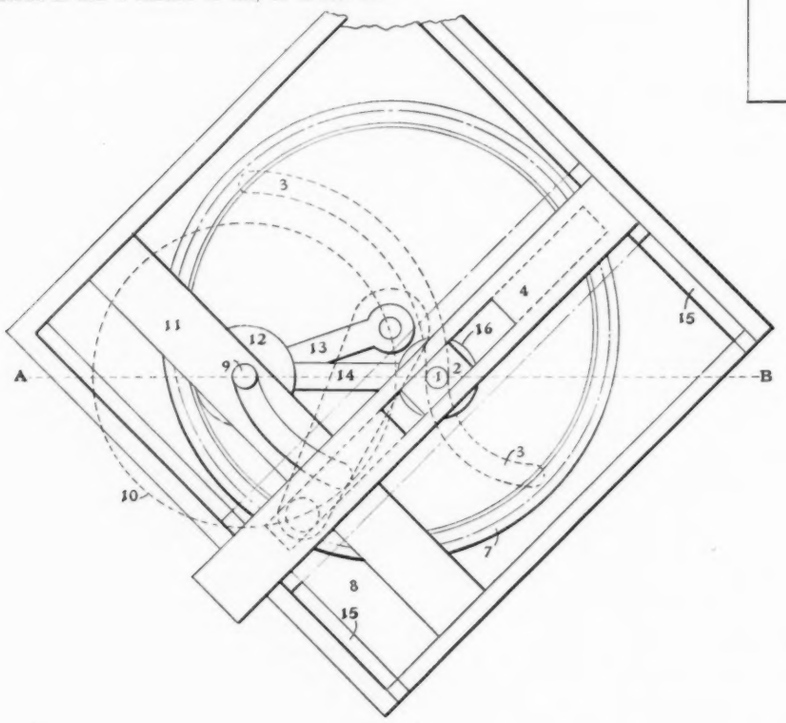


FIG. 4

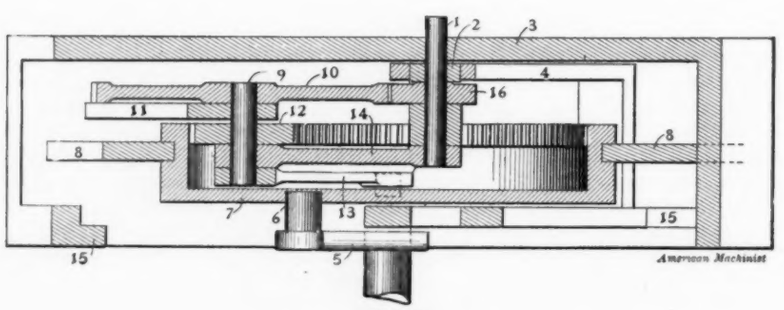


FIG. 4a

SOLUTION NO. 11 OF PROBLEM IV.

PROBLEM IV, SOLUTION NO. 15, FIGS. 7 AND 7a. E. PIERCE, ILION, N. Y.

This solution presents some features not found in the others, which Mr. Pierce's description will make clear. He writes:

"I have marked the center of the required path of travel by the line *m n*; the block to be moved, *d*. The base *B* is a large square iron block to which the ways are secured by screws. I propose to move the block *d* by a pitman and crank whose center line in its present position is *x y*. A section is shown in Fig. 7a, and *c* is the spindle which receives the motive power. The block *d* is convex on both sides to correspond to the radius of the outside guide of each of the opposite curves. The block *d*, in the position shown, is coupled with the auxiliary block *e* and as it nears the reverse curve it will pick up the auxiliary block *e'* by the pin *h*, which will move into the fork of the lever *f'* which it will press down far

enough to release the hooked end from the notch *g'*. This auxiliary block *e'* will be carried along with the main block *d*, which fits and acts like one solid block with it for this last portion of travel; and the first auxiliary block *e* will catch on a guide rail *i*, fastened to the base *B*, and be led into a pocket provided for this purpose. As the blocks *d* and *e* will now be following separate curves, they will diverge enough to release the pin *h'* from the forked lever *f* and a spring (not shown) forces the hooked end into notch *g*. As both sides of the block are convex, it will be necessary that at least one of the auxiliary blocks travel with it to furnish the concave side. At the tangential point of the two curves both blocks will be fully in contact with the main block."

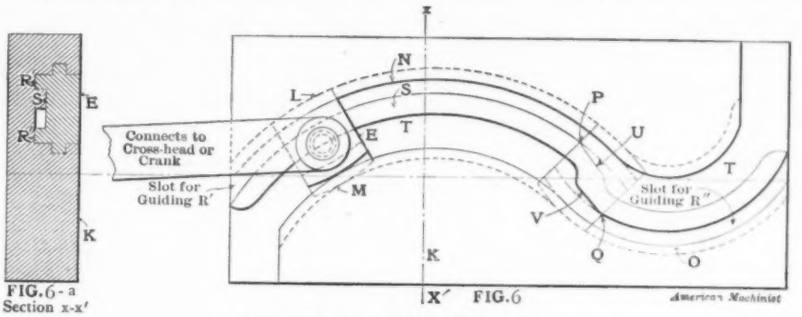


FIG. 6

SOLUTION NO. 14 OF PROBLEM IV.

PROBLEM IV, SOLUTION NO. 16, FIG. 8.
HAROLD SMITH, BRADFORD, ENGLAND.

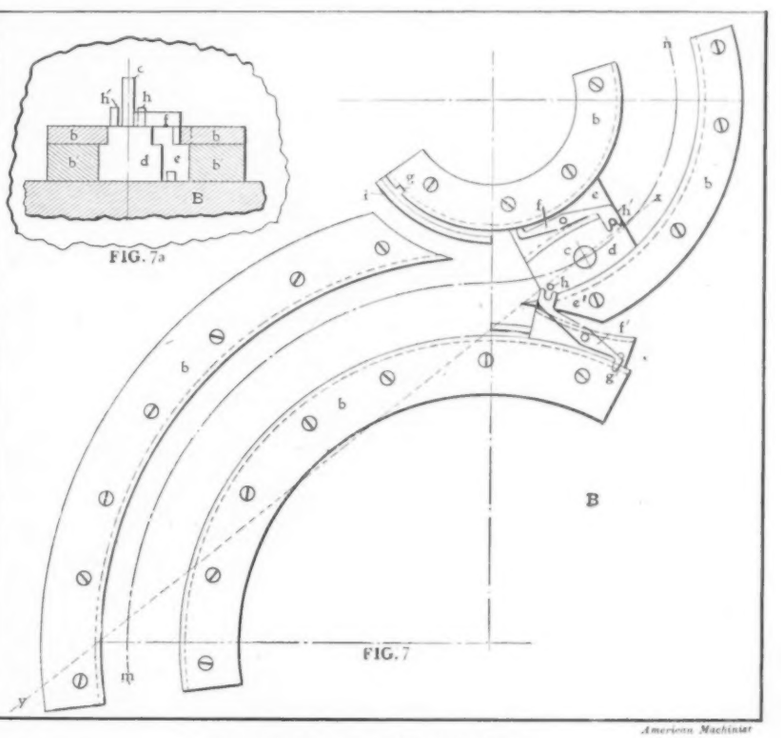
This solution is the last I have received for Problem IV. The drawing and the description are both very clear.

"In the elevation, *A* is the horizontal table containing guideways in the form of a *cyma recta*, which is shown in the plan. *B* is the block, *C* a toothed segment which is oscillated through 135 degrees by the pitman *F* driven by the crank-pin *G*. *C* gears with the gear wheel *D*. *H* is the pitch line of *D* and it coincides with the center line of the upper part of the guide. *J* is the pitch line of *C*, coinciding with the center line of the bottom part of the guide. The shape of the block will be seen from the detail drawing and also the particulars of the guide in the detail drawing of the same. Pitch circle *J* is twice the diameter of *H;* consequently, when segment *C* has made one-eighth turn, gear wheel *D* will have made one-fourth turn and the cup-shaped catches *E* will come together on the center line with stud on *B* between them. Segment *C* will move 90 degrees further and take the block with it, and catch on *D* will disengage with the block. On the return stroke the catch on *D* will engage the block at the center line and carry it forward along the small curve. The block has curved grooves in it to fit the tongues in the guide. The radii for these grooves are struck from the centers of the pitch circles when the block is on the center line between them. A careful study of the drawing will explain better than a written description how the block fits both curves and changes smoothly from one to the other."

PROBLEM V, SOLUTION NO. 1, FIGS. 9 AND 9a.
CARL J. ULMANN, NEW YORK CITY.

Mr. Ulmann was the first to contribute a solution of Problem V. The following is his description:

"The main driving shaft *A* is supported in a bearing which is a part of the cross-piece *G*, which reaches across the bottom of the casting. Keyed to *A* is driving



SOLUTION NO. 15 OF PROBLEM IV.

gear *B*. Fastened to the hub of *B* there is keyed gear *C*, while between *B* and *C* there is running loosely on the hub of *B* the large internal gear *D*. Furthermore, there is running loose on shaft *A*, above gear *B*, the two-armed sliding coupling *K*, which, at the end of its arm, carries the gears *H* (there are two of these for the sake of balancing the arrangement), which connect *B* and *D*. We assume gears *H* to have half the diameter of gear *B*, and if gear *D* be held stationary then coupling *K* will revolve with one-third the speed of shaft *A*. If shaft *A* has 180 revolutions, *K* will revolve with 60. Gear *C* drives gear *E*, which runs on a stud that is fastened to one of the arms of internal gear *D*. This gear *E* carries a crank-pin, which, by connecting rod *F*, is connected with a stud on one end of the cross-piece *G*, on which stud it can oscillate. Gears *C* and *E* would be of the same size, so that gear *E* would make one revolution to each one-third of a revolution of coupling *K*. It is evident that in making one turn it will swing back and forth the internal gear *D*, and by this means produce the acceleration and retardation which the sieve should have during each one-third turn. The upper half of coupling *K*, called *M*, is keyed to the sieve shaft, the sliding coupling allowing the sieve shaft to move up and down freely. In the recess of *M* there are inserted two half rings, which can be moved by pins fastened to casting *N*. This casting *N* branches out to the outside of internal gear *D*. *D* has cast to it on the two opposite sides lugs into which cam grooves are milled. In these there run cam rollers *P*, which are fastened to casting *N*. *N* is prevented from turning by the two guide pieces *O* which form a part of cross-brace *G*. It is evident that internal gear *D*, in oscillating back and forth, will raise and lower fork *N*, and with it the sieve shaft. This construction does not necessitate the eye at the end of sieve shaft, as shown in the problem. In order to show the entire construction in one cross-section, the internal gear *D* in the elevation has been turned into a position which it will never hold in reality in

relation to cross-brace *G*. This has been done with the object to show gear *E* in the elevation. I have added to fork *N* suspension springs, the other end of which should be fastened somewhere to the inside top of the casting. I think these should have a good effect in balancing the weight of the sieve, sieve shaft *L*, coupling *M* and fork *N*, and should thereby tend to much facilitate the movement."

This mechanism appears rather more complicated than necessary to secure the required action, but further comment is deferred till other solutions are presented.

Chemnitz Enterprise in Russia.

Consul Ernest L. Harris, of Chemnitz, furnishes a report on the successful enterprise of a Chemnitz company in establishing a machine shop in Russia. He says:

For many years it had been the policy of Russian statesmen to protect their own home industries by increasing from time to time the tariff on foreign-made machines. The result of this action was soon apparent. French and Belgian manufacturers established branch machine factories in different parts of Russia, and the Saxon Machine Factory, of Chemnitz, in order to keep a grip upon the markets already won at an expense of years of patience and effort, also followed suit, and in 1896 built a large factory at the above-named place, upon an area of 148 acres of ground.

The enterprise has been prosperous from the beginning. From 1897 to 1905, more than 700 locomotives have been made and delivered to the Russian railways. The war in the Far East has strained the factory to its utmost capacity. At the outbreak of the war the company made a contract with the Russian Government to deliver 102 locomotives within six months' time. During the present year the average output has been increased to twenty locomotives a month. In 1897 the factory was opened with 1,500 laborers. Since then that number has been increased to 4,000. There are few foreigners engaged in the factory, for the reason that it must be, and actually is for all practical purposes, entirely Russian in character. The value of the entire plant to-day is estimated at $5,000,000.

The London *Lancet* recently made the statement that the Underground Railway, with its ozonized air, created by the electric discharges and arcing of the motive apparatus, has a very healthy atmosphere, so that a trip in it is as good as one to Brighton or Margate. Possibly the scientists could prove the same thing for the New York Subway, but nevertheless, we believe that during the warm weather last summer most New Yorkers would have preferred to get their ozone at the seashore.

Japanese Trade.

Special Agent Crist gives, in the "Daily Consular and Trade Reports," some very instructive information about trade with Japan, from which the following is condensed:

The great bulk of the import trade of Japan is done through the medium of agents or brokers who have been long established here and who act for the jobber and wholesale merchant or the manufacturer who uses foreign materials in his plant. The native merchant in preparing to lay in his supply of foreign-made goods comes to the broker's sample room and there examines the great variety of samples with which every broker and commission house is well supplied by the manufacturers whom he represents. From these samples orders for the next season's stock are made up. Upon arrival of the shipment, delivery is generally at once taken by the merchant, thereby completing the transaction. It is not absolutely certain, however, that delivery will take place. The fact that there are failures to dispose of shipments with promptness is abundantly established by a visit to almost any jodown, or warehouse, of which each broker owns one or more of smaller or larger capacity, in accordance with the volume of his business.

If the market be up beyond the expectations of the merchant, he may possibly decline to accept the goods. It seldom happens, however, that a shipment is left indefinitely on the agent's hands, although that does occasionally occur. Some con-

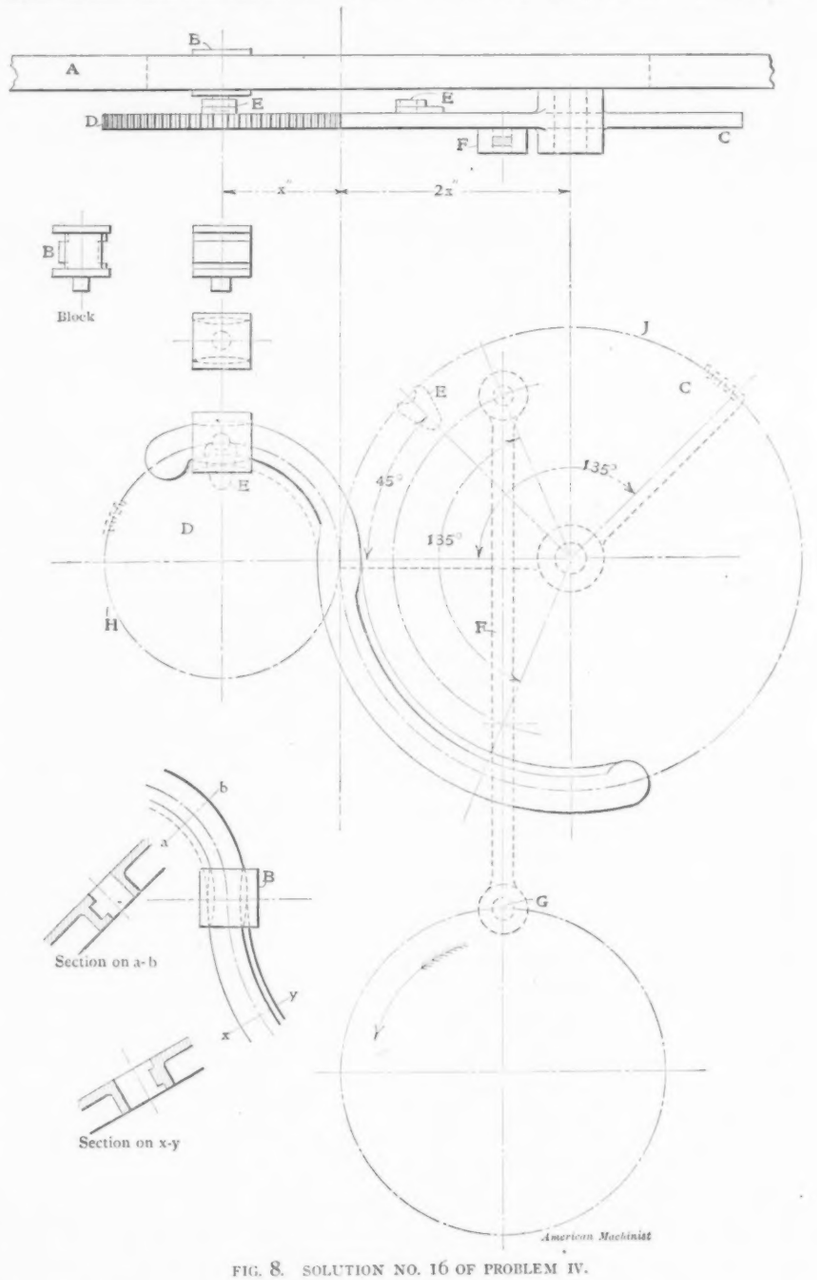


FIG. 8. SOLUTION NO. 16 OF PROBLEM IV.

cession will doubtless be made whereby the conditions are made easier and more to the liking of the merchant. It may be necessary, however, to hold the shipment until the market is more propitious, or even to sell to some other merchant who may desire to purchase such goods.

COMPROMISE THE RULE.

It is often deemed better to compromise the terms of the contract and effect a sale than to have recourse to the courts to enforce the contract as originally made. Going to court takes too much time, money, and loss of prestige to be desirable. In order to obviate such contingencies and to develop sound business relations for themselves and their principals, the commission agents make close study of the market conditions at home as well as in Japan, and acquaint themselves with the members of firms for whom they buy. By these and many other methods they familiarize themselves with the financial standing of their principals and with the many points which are essential to successful business relations.

Every commission house and broker has, in addition to the sample room, some place where his patrons can come in and take tea and talk shop. Through the medium of these talks he keeps himself in touch with the retail market on all lines which his patron handles, not only what he has sold him, but what he has bought from someone else. He can tell whether the last pattern or style of a certain line of goods is selling well, whether it is in order to suggest some change or modification. On the other hand, a change or alteration is often suggested by the native. The live broker finds out all these points and at once notifies his home office or the manufacturer of the particular line affected.

ENGLISH AND GERMANS WISE.

The English and German manufacturers pay heed to these pointers, and in the shortest possible time send out great varieties of such samples for inspection. Should these meet with approval, it frequently happens that a specimen output of two or three bolts in the case of textiles may then be sent to ascertain whether the pattern in its entirety meets the desires as fully as anticipated, thereby offering a further opportunity for examination and criticism. The Germans and English go further than this in many lines, such as printing and calendering presses, metal-working machines, lathes, milling and drilling machines, and machines of like kinds. In these lines they are repeatedly requesting their brokers or representatives to accept numbers of machines to be sold on consignment. This is never done by American manufacturers.

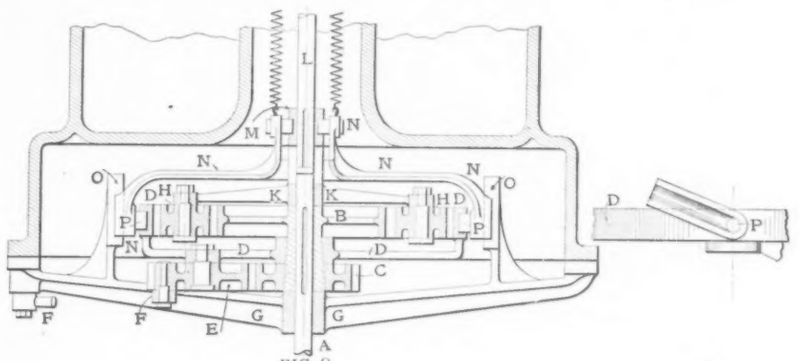


FIG. 9

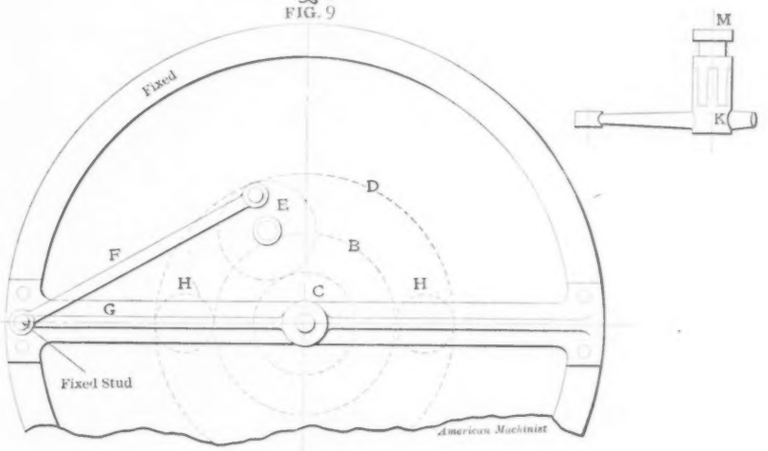


FIG. 9a

SOLUTION NO. I OF PROBLEM V.

METHODS OF SMALL CAPITALISTS.

The Japanese of small capital is entering business on a scale somewhat out of proportion to his finances, and he does not always feel able to invest a greater sum to obtain a plant that would last him for a longer period, when he can, with a smaller outlay, equip his establishment at a lesser cost with machinery which will serve him well but for a correspondingly short, or even much shorter, time. That a cheaply equipped factory will require more attention and repairs than one of higher grade does not yet appeal to him. Labor is very cheap in Japan; the laborer's time is therefore not so valuable that delays count very seriously in the profit-and-loss side of the ledger. The conditions here are such that the ambitious Japanese realizes the good business opportunities that exist, and is anxious to install without delay whatever equipment his business may require and his limited capital will admit, relying on the future (which is ever bright to the optimistic Japanese), and to his thrift and economy to bring success. The commercial progress of the entire nation is a testimonial to his faith in himself as well as to his frugality, and an evidence of the fact that his optimism has not been misplaced.

EMBARRASSING AMERICAN PRACTICES.

There are some practices followed by American concerns which cause great embarrassment to importers who have endeavored to build up an American trade. Several instances have been cited by commission houses who have English and German as well as American connections. The following will serve to illustrate: An immense business has been done by importers in heavy machinery of all descriptions during the past year, and Americans have participated to a most flattering degree. One concern, which has the sole agency in Japan for an American machine-manufacturing house, has obtained the trade-mark registration for this country, and is legally protected from infringement upon the part of any other person in handling these articles. The American manufacturer, intending to be alive in business, answered a request for quotations received from another broker in the same city where his agent was established. As a result of this correspondence, the new broker placed an order with the manufacturer, who stated that he had no sole agent representing him. This is doubtless his understanding of his relation with his agent. Upon the arrival of the shipment the matter at once came to the attention of the original broker, who served notice upon the new broker that he had a sole agency and he would prosecute any person taking delivery of the goods.

Such transactions as this do not tend to develop a friendly feeling for American methods or manufacturers. All parties concerned are more or less damaged—the persons for whom the commodities are purchased, the middleman in both cases, and the manufacturer as well. It also evidences an ignorance in America

of the most approved methods of building up a solid and lasting market.

If a German or an English concern receives a request for prices on the commodities which they manufacture, they at once refer the inquiry to their agent on the ground, who transacts the business to the satisfaction of all concerned.

Americans have the reputation of being ready at the first opportunity to cut out the broker and do business direct. This greatly deters established commission and brokerage houses from building up a market for American exporters. Such practice almost invariably results in losses, and in many instances to an abandonment of the market by the American, or a changing to some other field by the Japanese. Misunderstandings are bound to arise which should be settled at once, because of market conditions, but which can only be settled by the presence of someone familiar with both markets. Time, and in all probability the size of the business, will not admit of sending a person from America to adjust matters; thus the business is diverted by the difficulties presented, and the current goes along the channel of least resistance to some other country.

CATALOGUES AND CONTRACTS.

German catalogues come to Japan printed in English, the commercial language. English and German manufacturers do not hold themselves hard and fast to their wholesale-catalogue prices, but frequently make discounts therefrom and extend credits in addition. This deserves careful consideration by our manufacturers.

Much of the foreign trade is done on indents or contracts for definite quantities, with specifications as to details of style, quality, size, etc. It is generally left to the agent to select the goods in whatever field he may elect, although at times limitations as to country are made, and in certain instances the firms from whom bids are to be asked have been stipulated, thus further limiting the field of competition. Those commission houses doing the largest amount of general importing have either branches or agents in New York as well as London, and transact their business where the prices and conditions are most favorable. (Prices on continental goods are generally obtained through London.) There are several American commission houses established in the trade of the Orient who have their head offices in New York and maintain branches in London.

EFFECT OF PRICES.

When orders are given or specifications presented requiring certain foreign goods, communication is at once had with New York and London by mail or cable, giving full descriptions. New York and London prices are received and compared, and from these quotations bids are submitted by the commission agent to his principal in this market. All other things being equal, the lowest price is the governing factor in the equation From this it can be seen that through these American agents American manufacturers have as good opportunities for selling their goods in this market as those of any other country with which these commission agents are dealing. Many of these American agents have their branches in Yokohama, Kobé, Shanghai, Hongkong, Tientsin, Niuchwang, and other ports in the Orient, and thus cover a broad field, coming in touch closely with all branches and phases of the business and all classes of imports.

The method of procedure above referred to to obtain prices prevails generally with commission agents of all nationalities represented here where large business is done, and it is usual in the case of orders involving large amounts to request tenders from all available sources, thereby bringing about a world-wide competition. If, however, the question of time is one of importance American manufacturers successfully compete with all of the nations of the world.

OPPORTUNITIES FOR AMERICAN GOODS.

There are great opportunities in this market for American manufacturers to maintain the lead, if they will send their representatives to this country and have them on the ground to act either as sole representatives or in conjunction with the commission agents. In this way the manufacturers can be kept advised of modifications and changes in the character of the market requirements. This is being done to a limited degree by some American concerns, and with most flattering success. In every instance of this kind that I have observed the returns to the manufacturer have proven the wisdom of the undertaking and resulted in largely increased sales. Americans and American manufactures are in high favor with the Japanese, and in view of this the present strong hold on this market should not be relaxed, when, with but comparatively slight effort, expense, and attention the volume of business can not only be maintained but materially increased.

As I have before stated, the question of price ordinarily governs, and where the right kind of goods can be obtained at the best prices is the place the importer will do the most business, and every commission broker strives to do as much business as is consistent with safety to himself and satisfaction to his principal. Catalogues and correspondence alone accomplish but little.

EFFECT OF DISTANCE.

The distance from America is too great to admit of sufficient information being obtained by this method to be available in a market where others have direct personal information. And, on the other hand, catalogues without prices are absolutely worthless. Many manufactures are sold on such margins that quotation of prices is prohibited by the natural fluctuations in the market values of their component parts. Many commodities which to the unitiated appear prohibitive in their price can be sold here if one who is acquainted with the many phases of their utilities should come to this market and acquaint their users with the advantages possessed over similar commodities now in use.

EVERYTHING EASY TO EXPERTS.

Much may be accomplished by intending exporters in acquainting New York agencies of importing houses in the East with the lines which they have for export, and requesting notification of contracts to be filled in these lines. In transactions made through these channels the agent pays the manufacturer for the goods and directs him as to shipment. By these means American exports are brought up to this market without the expense incident to maintaining special representatives in this country, and a substantial export business can be built up.

CERTAIN UNPLEASANT FEATURES.

This method has its unpleasant features unless careful attention is given by the manufacturer to the shipments. Not infrequently delays occur in shipping, or in shipping by undesirable routes, or inefficient packing results in losses, *en route*, through damaged goods. When claims are presented to the American agent because of damaged consignment he refers it to the manufacturer, who produces evidence that the shipment left him in good condition. The agent in turn reports to his principal, who in the meantime has doubtless appealed to the steamship company and landing agent, who states that when delivery was taken their responsibility ended. The commission broker bears the loss, and in all likelihood turns to England for the next order of like goods, where conditions are such as to reduce to a minimum the occurrence of such embarrassing situations. In England the manufacturer is his own shipping agent, and attends to his export business through the well-organized export department of his establishment in Manchester, where factories and docks are adjacent to each other. In America the export agent may be 500 or 1,000 or more miles from the manufacturer, and, unless agent and manufacturer work in harmony in regard to details, difficulty will be found in bringing about satisfactory results; while, on the other hand, attention to details will undoubtedly result in a highly satisfactory increase in sales.

Henry F. Shaw, of Boston, well known in railway circles for his devotion to the problem of balancing the reciprocating parts of locomotives, has presented to Purdue University a model locomotive embodying his latest design. The model is constructed on the scale of 1 inch to the foot.

Laying Out a Single-Sheet Fire-Box.

BY W. B. EMBURY.

The accompanying illustrations show a good and simple way to lay out the single-sheet fire-box shown in Fig. 1, having the fire-box end of the crown sheet dropped below the flue sheet end, as is common in locomotives. This method is in use at the Salt Lake City shops of the Denver & Rio Grande Railroad and gives excellent results.

Fig. 2 shows an end view of the fire-box, *A* being the center of the crown sheet at the flue sheet, and *B* the center at the door sheet, the distance *A B* being the drop. First draw lines *C C* and *D D* above which the taper is to be, the sheet below these lines being out for parallel rolling. Line *I J*, Fig. 3, represents the length of the fire-box, it being understood that the illustrations are from sketches and not to scale. Make *I K* equal to *A B* of Fig. 2, and draw *J K*, which gives the length at the center of the crown sheet. Drop perpendiculars at *I* to *I J* and at *K* to *J K*, and make *K* 1 and *K* 2, Fig. 3, equal to *A I* and *B J*, Fig. 2, respectively.

To lay out the sheet we draw the center line *I J*, Fig. 4, equal to *K J*, Fig. 3, and draw *N N* and *O O* perpendicular to *I J*. Going back to Fig. 2, we measure from *A* to *C* and from *B* to *D*, and lay these distances down on *N N* and *O O* and make 11 and 22 of Fig. 4 equal to these distances on Fig. 3, allowing 5-16 inch for stretch in rolling. We then make *C N*, Fig. 4, equal to *C H*, Fig. 2, and similarly make *D O* equal to *D H*. Through lower 22 and *I* we then strike an arc by bending a thin straight-edge edgewise, and do the same with lower 11 and *J*. We next draw *H* 2 perpendicular to *O N* and tangent to 2 *I* and *H* 1 tangent to 1 *J* and the sheet is complete.

In all measurements for length of sheet allowance must be made for the take-up and stretch in rolling, which experience shows to be as follows: From *A* to *E*, Fig. 1, allow 1-16; from *E* to *C*, ¼; from *C* to *F*, ⅛, and from *F* to *G* take off ⅛ inch. From *G* to *H* no allowance is of course to be made. These measurements are to be used in stepping off the rivet holes.

The advantage gained by laying out this class of fire-box by this rule over any other that I know of is that Figs. 2 and 3 do not have to be drawn after laying out one sheet, as the distances 11 and 22, Fig. 3, can be remembered or put down, and used for future sheets.

Figs. 5 and 6 show the rolling operations in their proper order, templets being used of course to insure the correct form.

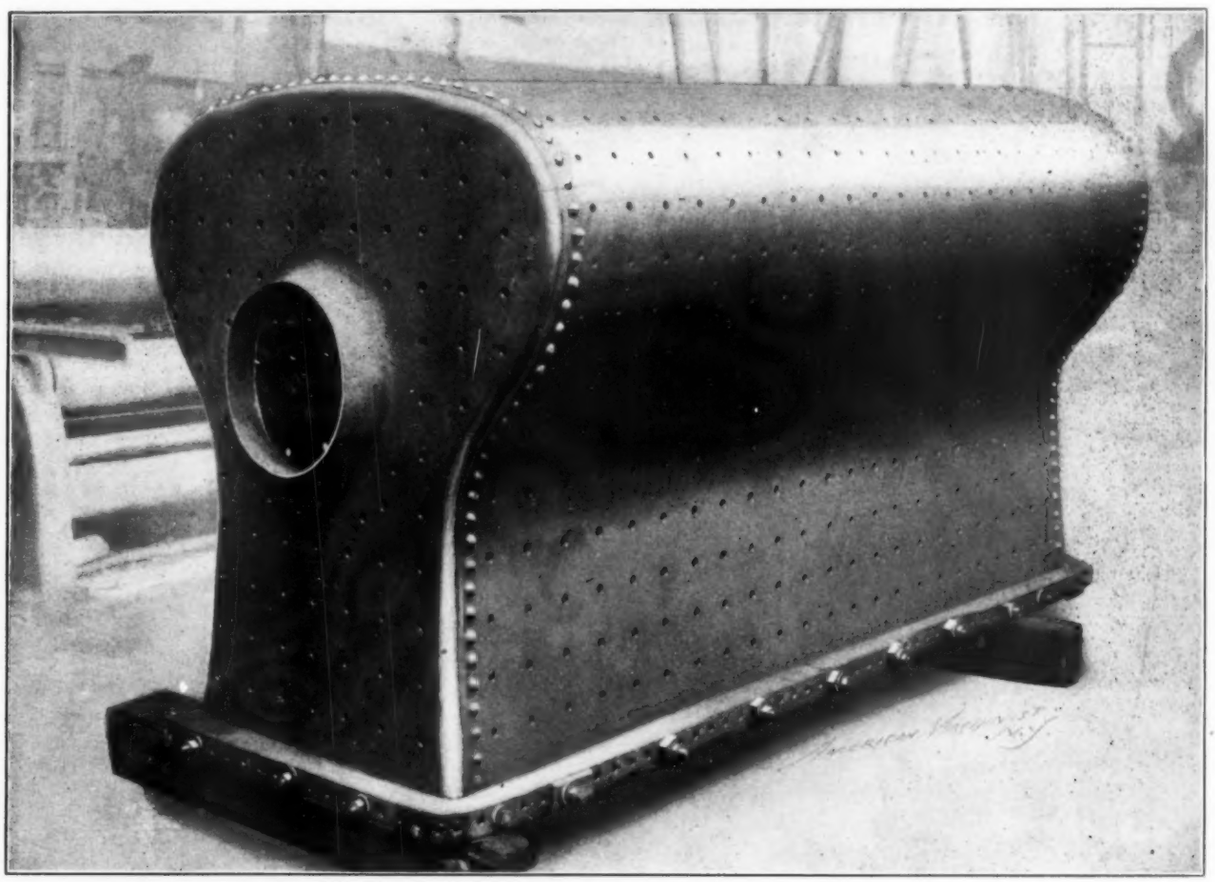


FIG. 1. A SINGLE-SHEET FIRE-BOX.

Some Phases of Our Patent System.

BY W. R. WOOD.*

The mechanical arts in general and the machine-tool art in particular have made vast strides within the generation, which progress is largely due to the influence of our patent laws. Notwithstanding this fact the public mind is divided as to the real value of patents, and the policy of patenting improvements as they evolve in the shop. This feeling is largely due, and naturally, to the well-known precarious nature of patent litigation, and partly to an incomplete understanding of the art of soliciting patents. As this is the primary step in obtaining a patent, so it is of primary importance in giving character and scope to the invention. It is a process of contract-making, with the inventor as the party of the first part, and the Government as the party of the second part, in which frequently the interests of the inventor suffer by carelessness or the inefficiency of the solicitor. By the terms of that contract, that is the patent itself, the inventor is bound, and if he has received less than his due, he suffers the natural consequences of one who has made a bad bargain.

In the earlier days of the practice, a

*Patent Attorney, Cincinnati, Ohio.

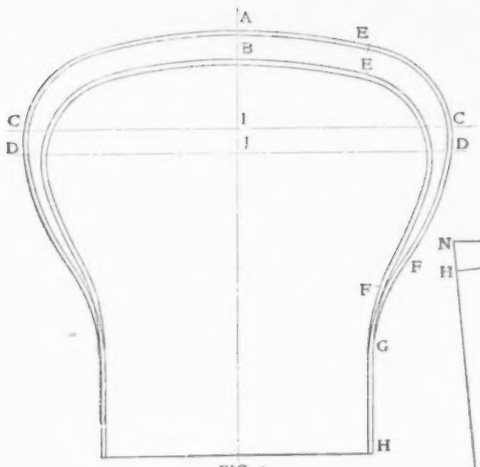


FIG. 2

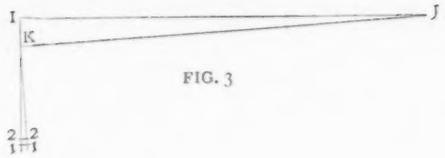


FIG. 3

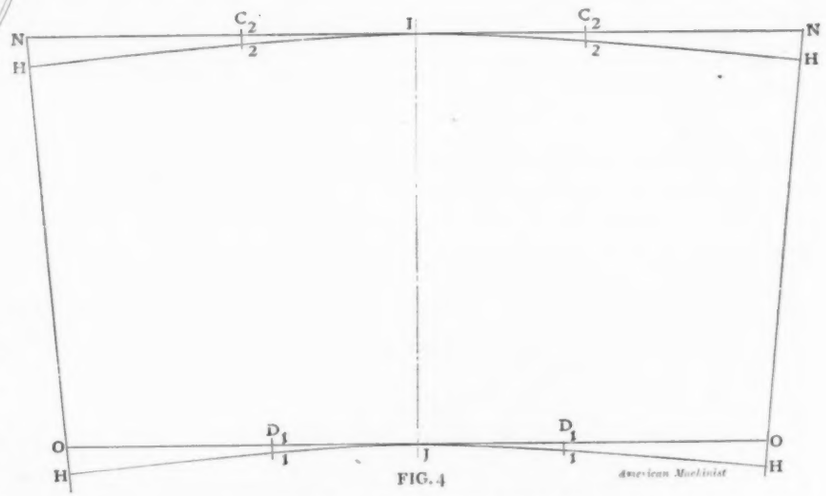


FIG. 4

LAYING OUT A SINGLE-SHEET FIRE-BOX.

patent was, as a general thing, a very loosely drawn instrument. Notwithstanding the fact that the laws defining the purpose and the construction of claims were well understood at that time, we find that in most of those older patents the claims would recite the elements in their literality and in their entirety, generally specifically naming each part by reference letter. This practice was pursued irrespective of the scope of the invention, and apparently without regard to the limiting significance of such a claim. As analytical methods have been devised to take care of the inconceivably vast and growing volume of patent soliciting, there has evolved a very refined system of classification, which not only simplifies the work of the Patent Office and the solicitor, but which has instructed the attorney in the art of claim drawing. The carefully drawn claim of to-day may still be faulty or deficient, too broad, or too narrow, but it represents an intelligent effort to analyze out from a complicated organization, the essential units of the invention involved, and to express the same in such carefully chosen terms as will not permit a sub-

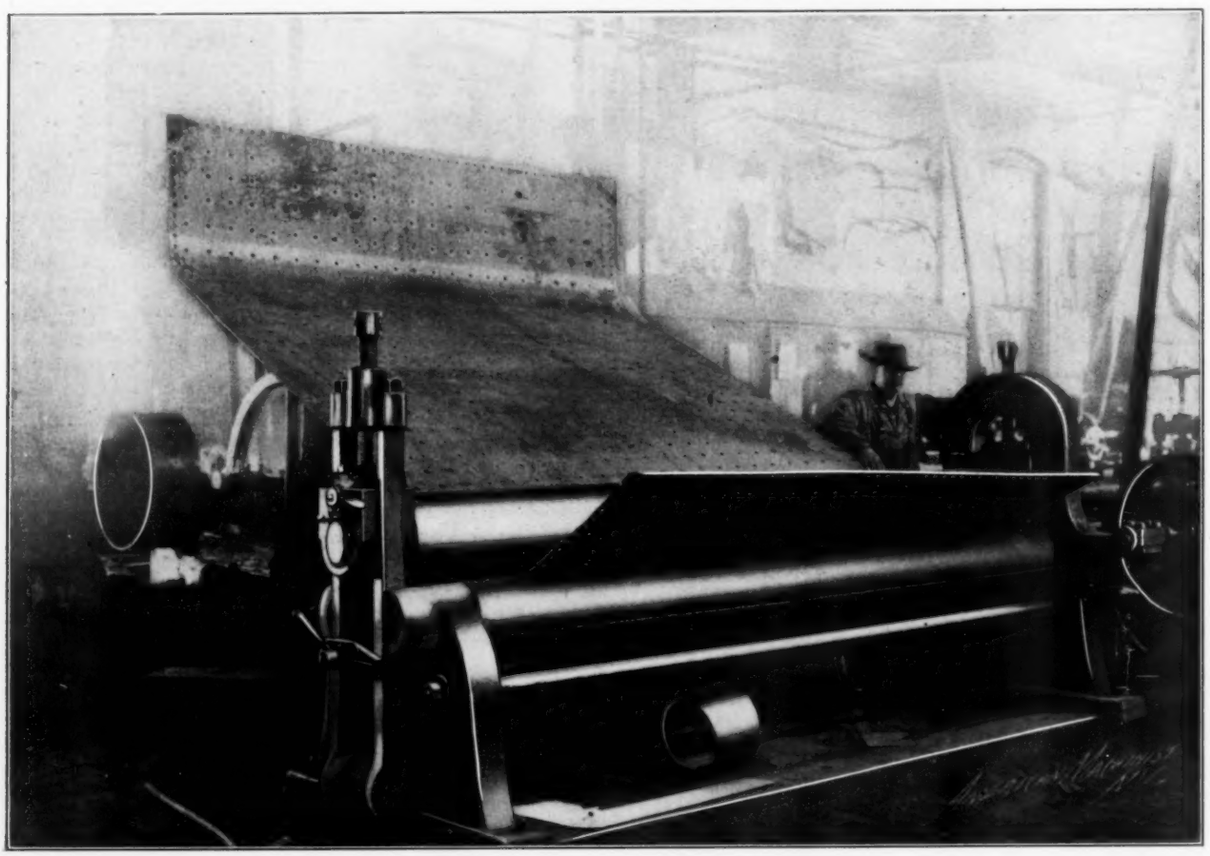


FIG. 5. ROLLING CURVE F G OF FIG. 2.

sequent imitator to evade the mere wording, while substantially appropriating the real fruits of the invention.

Consider for instance the attitude of the Patent Office and the solicitor toward machine-tool invention. To them, all machine tools look alike, irrespective of their many distinct types, in so far as they possess many elements in common, and a general similarity of organization. In compliance with this system of classification the machine tool is, as it were, broken up into sub-classes, such as headstock, tailstock, carriage, feed, spindle, and other distinct fragments. To one or another of these sub-classes each improvement is assigned, irrespective of the particular species of machine tool in which it is disclosed to the Patent Office.

This explains why an inventor, filing an application for a lathe, in which the improvements relate to the feed mechanism between the spindle and the lead-screw, and to certain features of construction in relation to the actuation of the carriage, is forced to divide his invention and to make several distinct applications for matter pertaining to a single machine. But this practice not only makes it easier for the examiner to pass intelligently on the merits of the improvements, but in the long run it is beneficial to the inventor, as it amounts to giving him a patent on each distinct feature of invention.

It is often stated that the United States will patent anything, and the existence of over 800,000 patents at the present time would seem to bear out this trite saying. But one who has carefully followed the process of patenting an important improvement, appreciates that it is no slight task to obtain adequate claims for an invention. Many an inventor turns the entire matter over to his solicitors and gives little attention to the prosecution of the application until advised that a patent has been granted, and does not even take the trouble to read it. Such an inventor does not appreciate whether or not his solicitor is doing good work, and he has little idea of the results obtained until he is involved in some infringement litigation and the Court invalidates his patent because it was not properly taken out. There is no reason why the inventor should not at all times be an intelligent critic of his solicitor, and see to it that the best possible results are obtained. One reason why this practice is not more general, is, that the nomenclature of the Patent Office differs so widely from that of the shop. But the purpose of this different phraseology should be almost obvious; for instance, if one element of an organization consists in, say, a well understood type of planetary gearing, it is referred to in the claims as *transmission elements.* This is to avoid unnecessary limitation.

In general the Patent Office is liberal, particularly where it can be brought to appreciate some practical novelty. It is not always easy for the examiner, however, to appreciate the importance of seemingly very simple changes. For instance, say an inventor has, by a very slight change in the conventional organization of a shaper, produced a new feed, which considerably extends the capacity of that type of machine. The examiner does not find any such arrangement in the shaper art, but he assiduously hunts up some patent on a freak planer, which has never gone into use, and tells the inventor that there would be no invention in introducing such a feed into a shaper. What the examiner may fail to appreciate is, that it often requires great ingenuity to endow a shaper with the desired capacity, without any substantial disarrangement of the existing organization of this machine, and that this retention of the standard make-up is an important shop consideration. And so, for a given invention in a lathe, an examiner may admit that he finds nothing like it in the lathe art, but refer the inventor to a milling machine, a drill and the grinder, and say that there is no invention in taking some of the elements from each of these three machines and combining them into a lathe. These are some of the difficulties which confront the solicitor and the examiner.

Whenever an inventor, however, produces a change in a particular machine,

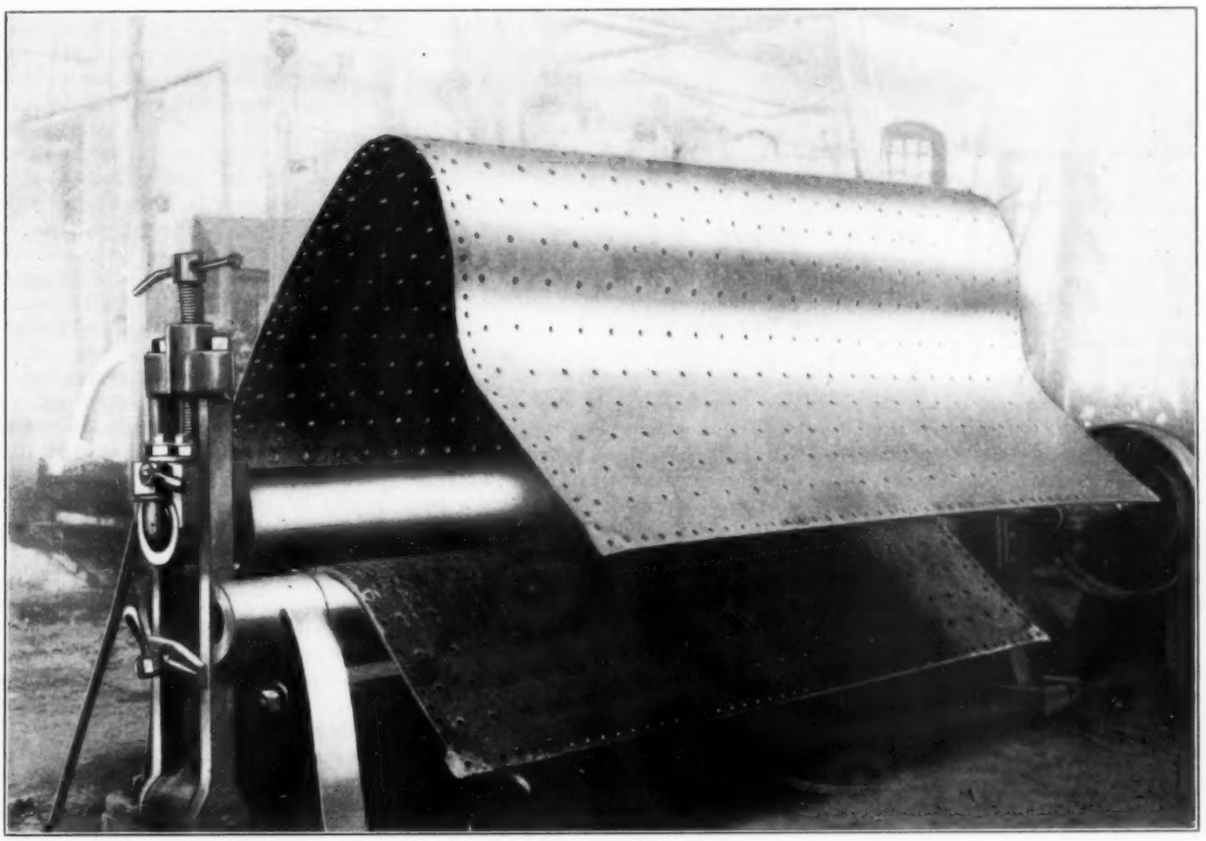


FIG. 6. ROLLING THE CURVES E C AND C F OF FIG. 2.

which accomplishes some useful result, whether in increased capacity, or cheapness, or efficiency, or in getting around some patent which he does not want to infringe, he is justified in insisting upon the granting of a patent for his improvement.

It often happens that an inventor perfects and patents an improvement on some older mechanism, and after manufacturing the same for a while, is sued for infringing some patent existing on the older machine. His natural reply is, "Why, I do not infringe your patent; I have a patent of my own, and the Patent Office did not even refer me to any other patent." From the frequency of such occurrences comes the plaint that the Government should never grant a patent that it will not protect. Under the conditions assumed, when the last inventor went into the Patent Office, the examiners carefully considered the claims *he* had presented to ascertain whether or not *they* were novel and patentable. If they disclosed an obvious improvement over the older machine, the examiner might possibly allow the claims without even referring the last inventor to the prior patent. This is because, in making his examination, he studies simply the claims of the pending application, and is not required by law to study the claims of the prior patents, nor is it any part of his duty to judge whether or not the machine shown in the pending application infringes some of these prior patents. In such a case the last inventor may not manufacture his improvement if it infringes the prior patent. If this were not the law the Patent Office would be forced to refuse patents on many radical and useful improvements because there was the possibility that they might infringe some earlier patent. Of course, a worthless or out-of-date machine may have claims so broad as to dominate a very meritorious later improvement. The courts, however, try to discriminate, and to so apply the law that a mere broadly drawn patent on a good-for-nothing machine will not stand in the way of a later, but practical invention. Such old patents have been very aptly termed "dog in the manger." It is naturally to the interests of the inventor to sustain only useful inventions.

This brings to mind another phase of the patent system which has received much discussion recently. "Should the Patent Office grant a patent on a worthless device, and should a patent solicitor prosecute such an application?" No United States court, or patent examiner, or reputable solicitor, should hesitate to answer this question broadly in the negative. But the difficulty is to form a trustworthy judgment. For instance, two of the most important patents which have come under the observation of the writer, both relating to machine tools, were for several years vainly offered to the trade before they were finally adopted. Both have since gone widely into use, and are to-day a living verification of the fallibility of the snap judgments of even the highest experts in the art.

There are, however, three classes in particular which seem very alluring to the inventive mind, namely, non-refillable bottles, car-couplings and nut-locks. Strange to say the most prolific patentees in these classes are farmers or men of little experience in the mechanical arts. To such a novice the solicitor can point out the long list of prior failures, which generally only makes him the surer of his own present success. The solicitor can then indicate, as a safe proverb, that nine times out of ten one cannot make money out of any invention foreign to his own line of business. But the inventor (?) of the worthless device always regards himself as just the exception to prove the rule. The solicitor should then deliver the following solemn admonition: "There is one dark and dismal room in the Patent Office, filled with musty and moldy patents, in charge of the oldest and most venerable examiners on the pay roll, and to this dungeon is consigned the class of non-refillable bottles under a life sentence. The weary examiners call it the 'Bone Yard.'" If after this, the dreamer of dreams persists in applying for a patent, the solicitor may conscientiously take his money to keep him from falling into the hands of more unscrupulous persons.

It is a hazardous undertaking for a solicitor to attempt to advise his client whether or not money is to be made from a proposed invention. He does not like to take the responsibility of advising the client to abandon what may possibly prove valuable, and he does not wish to encourage the useless expenditure of money for worthless patents. Worthless devices have been and will be patented, but the practice should be discouraged. The solicitor should strongly advise the inventor to make a practical test of his device before applying for a patent. If this thorough practical test rule were followed out, in addition to a preliminary search, much of the current soliciting would be eliminated. But frequently, the inventor who has only so much to spend, would rather place it in securing the patent, trusting to dispose of it profitably afterward. The speculative element is, after all, one phase of the patent system. When an inventor has patented his improvement, it is, so to speak, a certain amount of capital stock, which one man immediately loses and from which another gets rich. The difference is more apt to lie in the respective commercial abilities of the two men than in the respective merits of the two inventions. Experience has demonstrated that those companies which encourage the devising of improvements among their employees, and which patent and push such inventions as a matter of business policy, have become known as progressive and representative enterprises. Several of these concerns have departments which are practically minature patent offices, equipped with complete classifications of patents pertaining to the subject-matter of their respective manufacture. With such concerns the novelty of a proposed invention is pretty well threshed out before it is even submitted to the solicitor. Needless to say that these are the most favorable conditions for securing adequate patent protection. One improvement generally leads to another, until we have as a result, a long line of patents, each differing slightly from the other. This at least leads to some degree of individuality between machines of the same type as made by different concerns. To cite the variable speed art as an example, it was not many years ago that the familiar type of to-day was not in vogue, while at present, there are so many different arrangements of the same general principle, and so many different patents thereon, that one cannot but wonder if there is any limit to the ingenuity of the mechanical world. The day of fundamental or pioneer patents in the machine art is well nigh past, but the mightly volume of improvement patents rolls on increasingly, and both the industrial and the commercial arts are enriched thereby. If you produce an improvement that gives individuality to your machine, patent it if possible; it may not effectually prevent imitation; but it has a tendency in that direction, and it puts a certain stamp of originality and progressiveness on your business that is not without its value, both pecuniary and moral.

In Sweden a series of experiments is being carried out with a view of adopting the monophase electric system on the government railroads, should it prove all that is expected of it. The present tests relate to an 18,000-volt trolley system. The locomotive constructed for this purpose is to carry a main transformer of the oil-cooled pattern for lowering the voltage, and it will work in connection with a second transformer of like pattern. A number of tests will be made in the first place to find out what is the best operating voltage to use in the working of the lines under the various local conditions. The locomotive is of the 25-ton type, and has two main axles, each containing a 150 horse-power motor working at 25 cycles. Two locomotives can be coupled together and controlled from a single point. The locomotives use the pneumatic control system.—*Electrical Review.*

At Houston, Texas, recently, a switching engine took fire while its tender was being filled with fuel oil, and every combustible part of the engine and tender was consumed. The fire is said to have started at a leak in the pipe leading from the tender to the fire-box.

Letters to the Editor.

A Blanking and Bending Die—Hardening Dies Quickly.

The small formed piece shown in the sketch is used in all the S. & T. loose-leaf books of one style, and as we make a great many of them, we designed the die shown to cut out the operation of forming, which was slow from the fact that the burr side of the blank had to be considered in the finished product. The die is of compound style, and blanks and forms the piece at each stroke of the press. Having a spring stripper above and below the stock, the blank is forced back in the strip, carried forward one notch and forced through the dies at point *A*. *B* and *C* are duplicate plates inserted to preserve the round edge for forming and are secured in the die by screws tapped half in from the bottom, as shown.

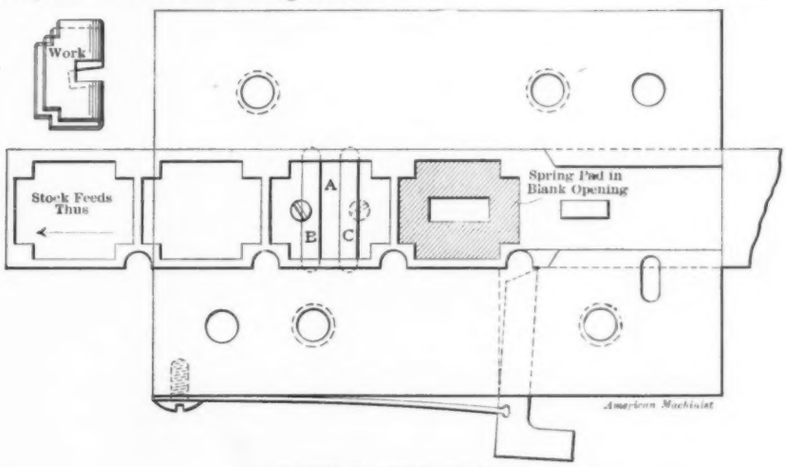
When grinding the die we take out the screws, drop down one thread and grind flush with the bottom. This scheme can be used for shallow forming; the operation then would be to carry the product forward and drop it out of the strip to the left of the die.

While employed by the Universal Adding Machine Company during the past year, I have hardened about 160 dies and punches of irregular shapes, the dies ranging in size from ½x3x3 inches to 1x6x12 inches, without loss, using annealed steel, such as Jessop, Styrian, Park Bros., etc. I believe in heating steel as quickly as possible. An ordinary blanking die, say ¾x4x4 inches, ought to be ready for the bath in six minutes or even less. All sizes mentioned should be ready in from six to twelve minutes, your oven being hot to start with. I try to use cold, clean water (Mississippi, Missouri and Chicago canal). Withdraw the work from the water as soon as results will allow (that is, if you have the die hardened ⅛ inch deep it answers for all practical purposes), and place in oil.

When the die has cooled enough so you can place your hand on it, put it back in the furnace and draw to relieve strains; then cool off, polish and draw to suit the shape and working requirements. I do not believe it makes any difference in the results how you dip the face, up or down, if you hurry; but I usually start the water in barrel to run about 41 revolutions per minute (a trifle more or less will be all right), and hold the die facing the current, as if it comes out hard it will be on the face and through the openings.

This quick-heat system, of course, does not apply to coin, medallion or heavy forming dies, where your die is liable to sink and loss of correct form or figure result. I have found ordinary sheet asbestos to give cleanest results for plugging up openings where there may be danger of a thin wall heating or cooling too quickly in relation to other parts. To relieve strains on work immediately after hardening, without fear of drawing too soft, try as an experiment: Polish a piece of steel and draw to different tempers, and as you do so repeatedly shake a few drops of water on the surface and note results.

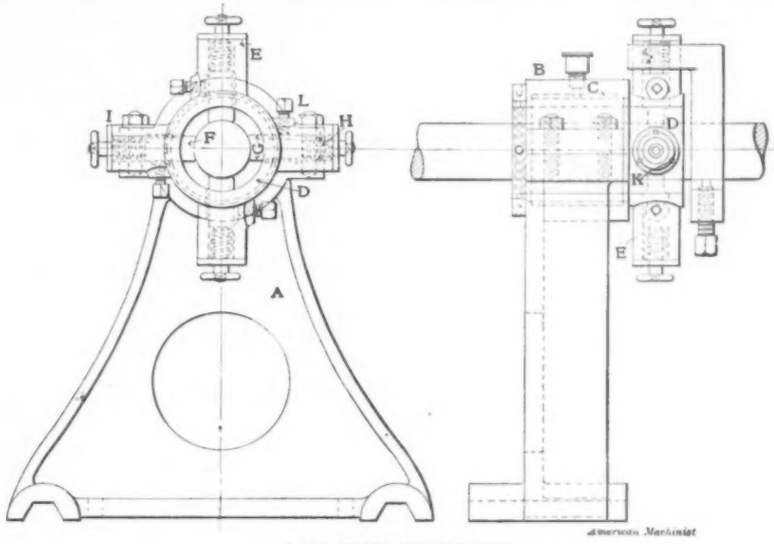
T. E. HEETER.



A BLANKING AND BENDING DIE.

A Shafting Steady-Rest.

The sketch shows a special steady-rest that can be used for turning long shafts, insuring perfect workmanship at a saving of time. It consists of a stand *A* that is bolted on the lathe in the usual way, and a cap *B*. The stand and cap have a recess *C* to hold anti-friction metal, and are bored to the same diameter as piece *D*. The latter is turned carefully, has a threaded collar, as shown, and four lugs *E*, each bored to receive jaws *F*. These jaws are turned and fitted carefully, size *G* in the holes of lugs *E*, and size *H* in caps *I*. These caps have a fitting of the same diameter as *G* and are secured by screws, as shown at *K*.



A SHAFTING STEADY-REST.

Jaws *F* are prevented from turning and guided by means of feathers, and at the end have knobs *M* screwed on. After the shaft has been centered and straightened, piece *D* is slipped on the shaft with its jaws pulled as far back as possible, put in its bearing and the threaded collar is screwed on the end and tightened.

The four screws *L* are now released and the springs push the jaws against the shaft. Screws *L* are then tightened. A dog on the shaft drives piece *D*.

The shaft is, in this way, steadied without the need of any turning, and can be finished perfectly round, as round as the bearing of the steady-rest. For this reason the bearing has to be made with care, and kept well lubricated.

J. M. MENEGUS.

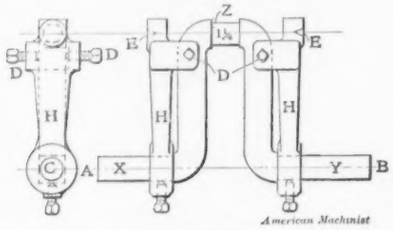
Brazing Gray Iron.

The principle used is to first decarbonize the gray iron for a slight depth. This is done by using oxid of copper—or some other chemical that will have the same effect—together with great heat to burn or otherwise remove the carbon, after which the job can be brazed like wrought iron.

F. R. WILLIAMS.

Jig For Turning Hand-Car Cranks in a Lathe.

A neat device is shown herewith, illustrating a method used in turning hand-car cranks in a lathe. In machining the bearings *X* and *Y* the piece is centered at *A* and *B*, and the work done very easily, but



THE JOB AND THE JIG.

when it comes to turning the bearing *Z* it has been found necessary to use an arrangement as shown, two arms *H* being required to do the work. The hole *C* is slipped over the bearings *X* and *Y* and the set-screws *D* tightened securely on the crank, as shown. This brings the centers *E* in line with the center of the bearing *Z* and the work is then ready to set in the lathe, the centers of the lathe fitting in the centers at *E*.

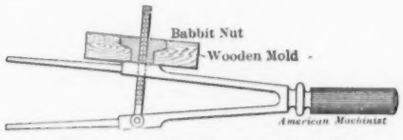
In turning the bearing *Z* a long tool with a 1¼-inch face is used, thus finishing the work in one cut. The tool is braced underneath by a ¾-inch bar placed at the cutting end of the tool.

This device will be found to be a great saving in shops performing this class of work, as a man can, with this arrangement, finish the bearing *Z* in a few minutes, while formerly it required several hours.

G. E. B.

A Babbitt Nut for Bow Instruments.

The sketch will show a method I have successfully used to make new nuts for bow instruments when the old ones strip. Take a small piece of wood 3-16 or ¼ inch thick, and drill a hole about 5-16 inch diameter part way through. Drill the rest of the way 5-32. Put this over



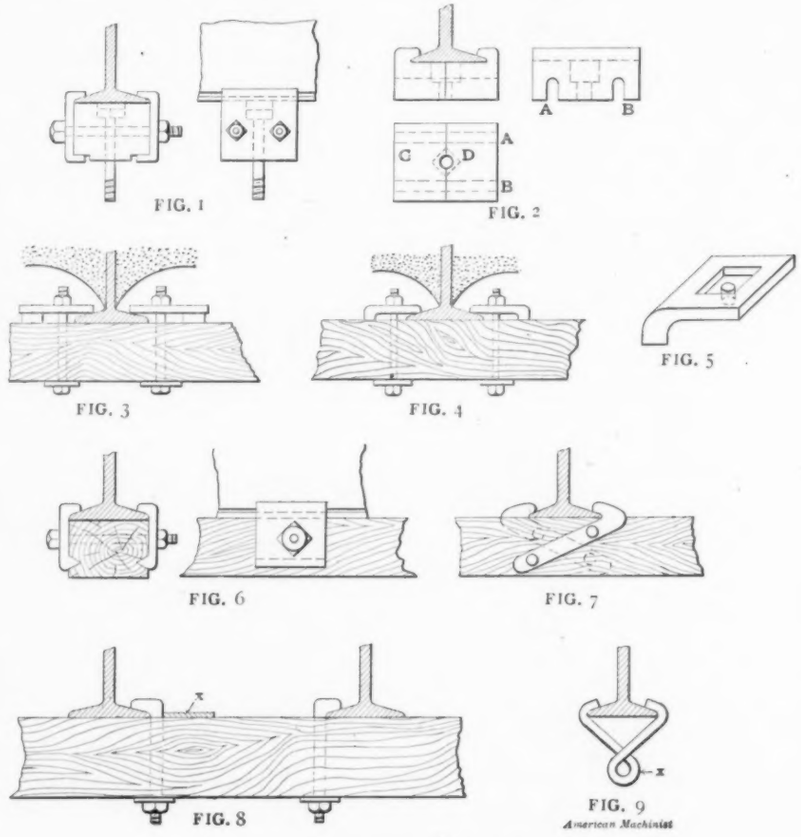
BABBITT NUT FOR BOW INSTRUMENTS.

the screw, tying it fast to one leg of the instrument. Melt some good, hard babbitt and fill the cavity in the wood. When the metal sets, split off the wood, and you have a nut that will last for years. The grip part of the nut can be nurled, if wanted, by making fine ridges in the mold. If nothing better is at hand, the babbitt can be melted in a blacking-box lid. Should the nut stick, tap lightly with a small hammer, turning it at the same time. This will make the nut turn freely on the screw.

WM. C. MCLEOD.

Supporting Hangers From I-Beams.

I notice at page 606 a letter on supporting shafting with structural shapes, and send you herewith methods used in hanging from structural shapes. In many cities there are fireproof buildings in which manufacturers rent floors or parts of floors and must fasten the hangers to the lower flanges of the I-beams, as in Figs. 3 or 4. The nuts are shown on top, as there is seldom room to get a bolt in from the upper side. Fig. 3 is a common method, and Fig. 4 is an improvement on it which consists of a gray-iron clip, Fig. 5, with a square hole in the top to keep the nut from turning. Fig. 1 shows a beam fastening for suspending hangers or motors



SUPPORTING HANGERS FROM I-BEAMS.

from I-beams, or for eyebolts for chain blocks. Fig. 2 shows a clamp for hangers or timber. Bolts are slipped in at *A* and *B*, holding *C* and *D* together, and cannot drop out after the hanger or timber is in place. Fig. 6 explains itself. Fig. 7 shows a method of holding a strip of wood to beams for fastening electric wires. The clip is about ¼ inch thick and made of gray iron. Fig. 8 is not a good method unless a plate *x* is secured to the timber, as the bolt has a tendency to split the timber. Fig. 9 shows a method of supporting piping. If an insulator is put in the eye *x* it makes a good electric-light wire supporter.

HERMAN JONSON.

Keeping the Hands Clean in the Machine Shop.

I see in Letters to the Editor that reference is still being made to the above subject, and I wish to call attention to the merits of sawdust for this purpose. The best kind to use is that from jig or band saws, or from small crosscut saws, but that from any small circular saw will do, as it should all be sifted to take out the splinters, small pieces of wood and coarse sawdust. The handiest place to keep it is in a good stout wood box of not less than two bushels capacity, and about 18 inches deep. Fill the box about two-thirds full, so it will not get so much sprinkled on the floor around the box.

For a repair shop around mills and other places where much repairing of old greasy machinery is done, it is far better for the first cleaning of very black, greasy hands than anything I have seen used. Just dive the hands into the sawdust and rub them together as if washing in water, and they will soon be so clean that with a little dusting off with a brush, a rag or bunch of waste they will be clean enough for almost any kind of machine-shop work. One of the good things about this use of sawdust is that it is no trouble to get the men to use it. See them come into the shop with black, greasy hands and they go straight to the sawdust box as naturally as a duck takes to water. The men also

soon get to putting the smaller pieces of greasy repairs in the sawdust to clean them, in preference to using waste.

One of the best things about it, and which appeals most to the proprietor who has to buy the waste or rags, is the great saving it effects in their use, for the workmen soon come to prefer the sawdust, and in some repair shops it would reduce the bill for waste one-half. Have plenty of the boxes for sawdust located at convenient points around the shop.

To those who have not tried sawdust for this purpose I urge them to try it, as it will cost almost nothing and I have seen no possible objection to its use except that it gets sprinkled on the floor around the box somewhat. BELL CRANK.

Two Ways of Constructing a Milling and Drilling Fixture.

The gray-iron ring *A*, drawn in plan and half section in Fig. 1, is about 11 inches diameter and has a hinge *a* which is drilled and milled at one setting, the drilling spindle being attached to the frame of the miller, and the drill guided by passing through a hole on a hardened steel stud when the platen is brought up to a stop. The fixture shown in Fig. 2 was supplied by a toolmaking firm of good repute, but was discarded for two reasons. It is important that the center of the hole in the hinge should be level with the top face of the ring. Now, as shown in this design, the ring rests on the lugs at the back, and as the height *b* is not constant (castings *will* vary) this condition is not fulfilled, as the height of the drill cannot vary. To explain the other reason, it will be noticed that the ring is very thin and therefore easily made to vibrate; and the three points at which it is held not being sufficient to prevent this, the noise created during the milling was simply intolerable. To stop this "music" and to drill the hole accurately, I designed the fixture in Fig. 1. The hinged ring is here shown inverted, with its face resting all round on top of the fixture. The height of the face is therefore constant. The tongue on the face fits a groove, thus accurately locating the ring, which is held firmly down at six points, the pressure being applied through a wheel nut. The foot (drawn in section in Fig. 1), which rests on the hinge, is sufficiently wide to cover it, and also comes well over the end, thus effectually stopping the vibration. The cutter is shown in outline; the drill stud being partly cut away to clear the mandrel. The threads of the clamping wheel and stud are cut away in three grooves to save time in tightening down. G. H.

W——, England.

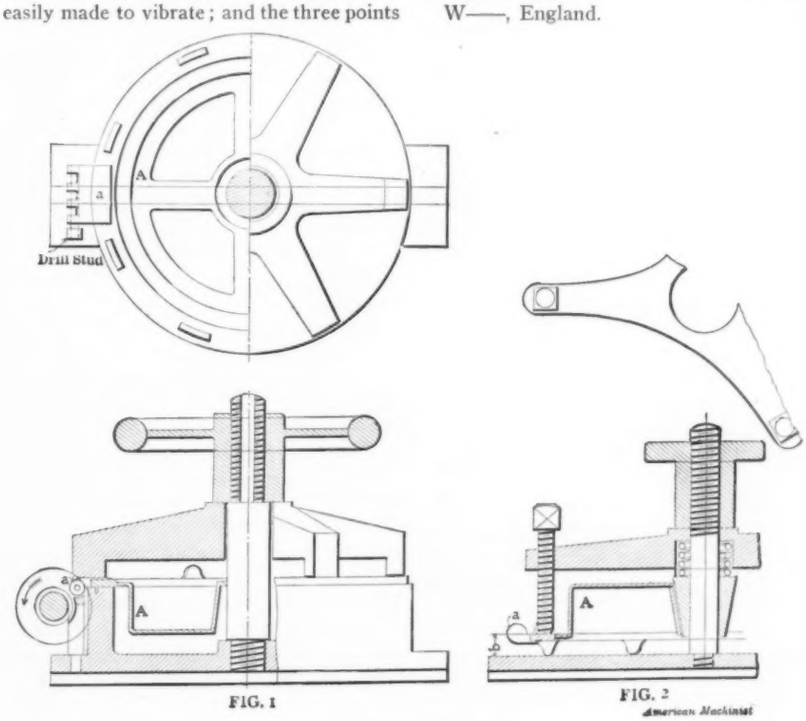


FIG. 1 FIG. 2

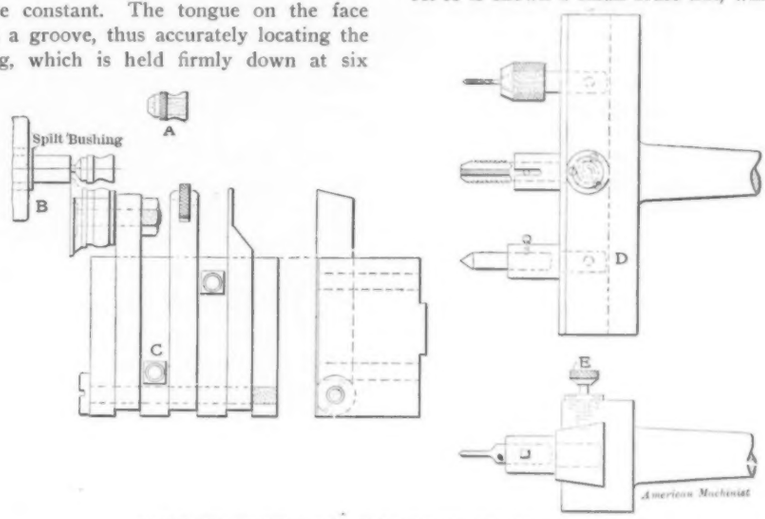
American Machinist

THE TWO FIXTURES.

Doing a Screw-Machine Job in the Lathe.

We had a few small jobs to do that did not warrant the purchase of a screw machine, so, having plenty of lathes empty, we rigged up the tools shown in the drawing.

At *A* is shown a small brass nut, which is used on a spray pump. It is tapped out and has a small hole clear through it. The outside is finished, as shown, and nurled. *B* is a chuck, which screws on to the spindle, and has a split bushing to grip the stock without marring it; it is tightened by a clamp-screw. *C* is a tool block, which fits on the cross-slide and carries three tools, which are swiveled at the rear ends. Thus the forming tool, after being used, can be swung back so that the nurling tool can do its work, and the nurl, in turn, is tipped back to avoid interference when the cut-off tool is used.



TOOLS FOR DOING A SCREW-MACHINE JOB ON THE LATHE.

The tool-holder *D* fits into the tailstock spindle, and the tools are secured in the dovetailed slide. A spring stop *E* locates each tool as the slide is pushed along in the guide.

The fixtures worked first rate and saved lots of time, as these brass nuts were made on a Fox lathe before in two settings, being first drilled and tapped, then screwed on an arbor and finished on the outside. SAMUEL CORONA.

A Device That Did Not Fail—Filing Information.

"A Device That Failed," at page 506, by J. M. Menegus, calls to mind one that we had made for a somewhat similar purpose. While Mr. Menegus' device may have been wrongly designed, I do not believe it was tried right. Our machine operator raised the same objection in general and used the same tactics to prove his case, and while the device failed it did not go to the scrap heap after his trial. We made a new arbor and when ready again we gave the operator a week's vacation. A

new man on the device had apparently decided that we were paying for at least a fair trial of the tools, and it did not fail again, but the output increased from 6 to 60 pieces per day. Our satisfaction over the first operator's absence was so great that we increased that vacation indefinitely. All of the apparatus devised by me have not proved a complete success, but a fair trial frequently develops a weakness that can be overcome and what might otherwise be a failure can be made at least a decided improvement. I have know a molder to deliberately crush a mold rather than see a good casting made in a different way from one that had produced nothing but failures.

I would not consider my paper read if I had not carefully gone over the advertisements, from which I have received much valuable information. I have a small vertical filing system, the folders of which have such headings as "Lathes and Attachments," "Drills and Drilling," "Screws, Bolts and Threading Devices," "Presses, Punches and Dies," "Good Design," New Ideas." When reading the paper it is easy to make a note on a slip of paper of the size of the standard card index pertaining to any subject, and from the advertising pages to cut out any illustrations or advertisements that may be of interest and drop them into the proper folder. For information collected in this way I frequently receive remuneration and in addition have a complete up-to-date general machinery catalogue on the lines appealing directly to me. TED.

Punching Hard Rubber.

I recently discovered something which was entirely new to me and may be to others. Some time ago I was in the electrical business, and among other things had several different kinds of hard rubber insulators to get out. On account of the well-known tendency of this material to curl up, when heated sufficiently to be handled in the press without danger of cracking, I did not dare to do much in the way of piercing and blanking dies. One piece in particular was a very awkward and consequently rather expensive one to make by hand, and was required in quantities large enough to warrant trying desperate remedies.

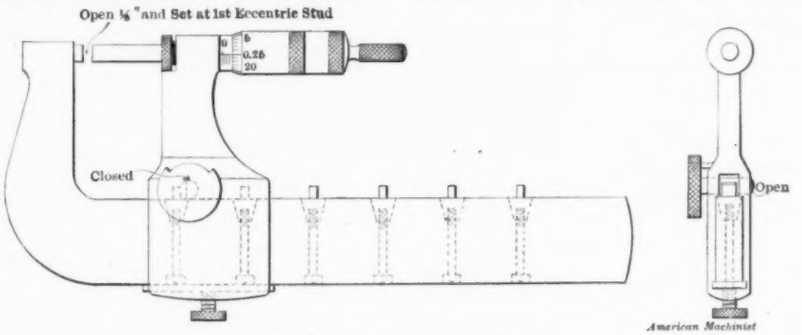
I thought the matter over, and decided to try the effect of heating the punchings and cooling them between flattening dies in a foot press. I had a die made, piercing and blanking the piece. The punchings, I must say, did not look very encouraging; they were of nearly every possible shape, except flat. I rigged up a gas stove and a pan of water by the foot press and threw in a handful of stampings, set up the flattening dies and got ready for operation. Imagine my surprise when I picked a few stampings out of the hot water and found them perfectly flat without ever seeing the flattening dies. I do not mean approximately flat, but as nearly flat as the sheet of rubber they were punched from, with no rings around the pierced holes nor anything that would even show from which side they were punched. Since then we have had no trouble in making even difficult stampings from hard rubber, the "hot-water bath" leaving nothing to be desired.

This may be an old trick to some, but I believe the majority of the readers of the AMERICAN MACHINIST are not acquainted with this simple and effective treatment. H. K. HARRING.

[Our contributor sends some sample punchings, showing their condition before and after the hot-water treatment, and they fully substantiate his statements.—ED.]

6-Inch Beam Micrometer.

The sketch shows a 6-inch beam micrometer that any mechanic can make with little trouble. After the forgings are shaped out holes are drilled and reamed approximately 1 inch apart, and taper eccentric pieces to fit held in position by screws as shown. The pins can be easily adjusted 1 inch apart by turning the eccentric studs. I. N. QUIRE.



SIX-INCH BEAM MICROMETER.

Another Noon-Hour Yarn.

R. B. Boone's noon-hour yarn at page 599, Part 1, Vol. 28, reminds me of one, and also impresses upon me the fact that a bogus reputation for being a skilled mechanic is a great deal better than none at all.

It was in 1893, when trade was bad and jobs scarce. Owing to election being near, and the master mechanic of a certain print works running for sheriff, a friend of mine got me a job at the works on the tacit understanding that he would support Mr. Hale in his run for office in return for his giving me a job.

The second day I was there, Mr. Hale came to me and said: "I understand you are a toolmaker; get me out a set of 5-16-inch taps." I protested, saying that an 18-inch lathe—in such condition as theirs—was no tool to make small taps on, and further that he could buy a dozen taps for less money than it would cost for me to make one. All of which was to no purpose, for, said he, "You told me you were a toolmaker, and I intend to see for myself. I know the equipment, and don't care what the taps cost."

I had no micrometer with me—as the work was of the coarsest character—and neither had any of the other men. There were, however, a nice set of caliper gages, though what use they were in that shop I never found out.

After fixing up the old 18-inch Bement & Docherty lathe so that the spindle was fairly snug in its bearings, I turned the three blanks for the taps, leaving them as near as I could guess about .003 larger than the 5-16-inch snap-gage. After rummaging around the shop I found a 5-16-inch tap that had been broken before it had done much work, but which still had about 5/8-inch of thread on it. This I ground taper, and threaded with it a solid die I made out of an old flat file.

After threading my three blanks I ran the solid die over them and brought them to size—what size I had no means of measuring, except that they were a little larger than snap-gage. I then filed the flutes in them—three in each in honor of Mr. Hale, who was a Scotchman—and after squaring the ends and marking the size with figures—the smallest in stock—large enough to letter a sign with, I tempered them and took them into the office.

What was my surprise to see Mr. Hale dive into a drawer and pull out a michrometer. After carefully calipering each one he turned to me and said:

"I wouldn't have believed it possible with our equipment; how did you caliper them?"

"I just used the snap-gage and allowed about .002 over."

"You have made a fine job; they are all .0015 over size, which is a good point, and you have put three flutes in them. Where did you learn that?"

I told him in Glasgow.

Finally he said: "I have not a man in the place who could measure three pieces by guess and get them so close. You and I—I bet—are the only men in this town that know that three is the correct number of flutes for a tap. You may report to the foreman of the roll department, where the work and wages will, I think, be more to your liking."

It was a fake that got me the raise in

work and wages, but as I was able to hold my end up no harm came of it. I still know Mr. Hale, but have never had the heart to tell him the true tale of the taps.

DIXIE.

A Turret-Lathe Job.

We lately have had several thousand counting-machine wheels like Fig. 1 to make. They had to be bored and reamed, both ends of the hub and both sides of the rim were faced, and the outside turned. The hubs project slightly beyond the rim to allow bearing at the ends of the hubs only, five of the wheels when in the assembled machine being placed on a shaft side by side.

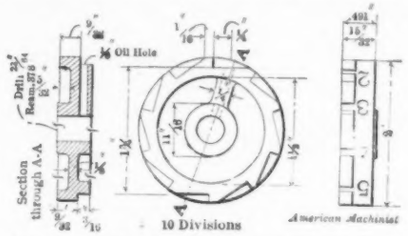


FIG. 1. THE COUNTING-MACHINE WHEEL.

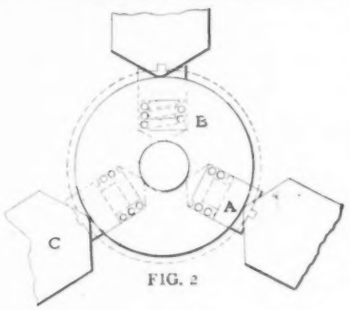


FIG. 2

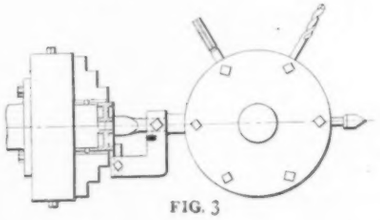


FIG. 3

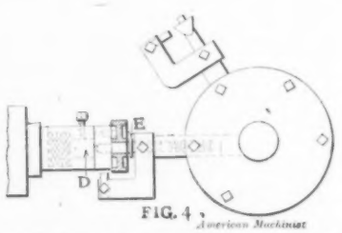


FIG. 4

TURRET TOOLS FOR MACHINING THE WHEEL.

The rough gray-iron casting of the wheel was first placed in a universal chuck in which had been previously placed a stop, Fig. 2. This is made from a piece of cold-drawn steel (though gray iron would have done as well), bored a trifle larger than the hole in the wheel, to allow the drill and reamer to pass through, also making it possible to put it on a mandrel to turn and drill. The drilling for plugs *A* and springs *B* was done on the milling machine. The springs force the plugs against the chuck jaws *C* and thus keep the stop in place as the jaws open to admit or release the work.

Fig. 3 shows the work in place in the chuck; the centering tool, drill and expansion reamer having performed their required operations. The counterbore and facing tool are inserted in a simple holder and are of air-hardened steel.

A special chuck *D*, Fig. 4, was made to finish the other side. This was turned to fit a sleeve (which screws on the spindle and is used for various jobs) and is held in place and driven by a set-screw. A small plug locates the wheel, which is driven by another plug contacting with the oil-hole rib. The wheel is a nice snug fit on the central plug and a slight recess formed around the central plug permits the thrust of the counterbore and facing tool to be sustained by the rim, keeping the wheel rigid and straight.

For facing, the same tool is used as for the opposite side. For turning, a like tool is used except that instead of a counterbore a spring plunger *E* was fitted in the holder, the spring keeping the plunger hard against the wheel to hold it firmly during the turning operation. The spring plunger is prevented from coming out of the holder by the point of a screw which enters a seat in the side of the plunger. The numbers are put on the wheel in a later operation.

C. H. RAMSEY.

Cutting Racks.

Your correspondent, E. H. Fish, at page 54 of the present volume, brings to my mind a bit of my own experience in this line, which may possibly interest other readers of the AMERICAN MACHINIST. We had to use a fair quality of gray-iron and machine-steel racks, and after sending them out to cut for a while, the boss got tired of the price charged and wanted to rig up to do them in our own shop. The first attachment we tried was very much like the one described at page 54 by Mr. Fish, in which nearly every reader of the AMERICAN MACHINIST will recognize the principle of the Fellows rack-cutting machine. In our case, cutting 5-pitch gray-iron racks, it was not a success; the spring of the cutting spoiling completely the shape of the tooth, till it would have been nearly impossible to have recognized the finished rack as an involute.

Our next trial was with a milling machine rack-cutting and angular milling attachment. This was purchased from a leading firm of London agents, and by its aid our boss thought we were on the way to solving our rack-cutting problem. The attachment was one of the usual sort, with a small pinion on the cutter spindle, so that the work would clear. The diameter of the shaft to which this pinion was keyed was ¾ inch, the pinion being driven by another wheel about two and a half times bigger, which was also keyed to a ¾-inch diameter shaft. The speed at which 4-pitch gray-iron racks could be cut with this combination may be imagined. We used a ¼-inch milling cutter for stocking out the teeth, and it took fifteen minutes to go through a blank 1⅞ inches wide, and then it took the same time for the finishing cut, so that it took half an hour to finish one tooth. We daren't try any steel blanks after this experience with gray iron.

After this we proceeded with an attachment of our own design to fit one of our milling machines. It was made on a similar principle to a rack-cutting machine constructed, I think, by the Warner & Swasey Company. It has a large wheel on the cutter spindle, the spindle being a good stiff one, and carried out about 20 inches from the cutter, so that racks 36 inches long could be cut by resetting. Needless to say, the attachment is a clumsy affair; it takes two men all their time to lift it into place, but when it gets there it is a great improvement over any of our previous rack-cutting attachments. The first time we tried it was on 4-pitch gray-iron blanks, which we cut, without a stocking cutter, at a rate of 3 inches a minute feed. We afterward mounted a stocking cutter, spaced the correct distance, at the side of the finishing cutter, so that the finishing cutter would not have as much to fetch out; and on the first cut with both cutters, cutting out of the solid, we had no difficulty in cutting with the fastest feed on the machine, namely, 3½ inches a minute. After bothering with the graduated dial (graduated in 1-500 inch) for some time, we made a standard rack, or rather four standard racks, one for each of the pitches we used, and fixed it on the front of the machine; we also fixed a catch (to engage the teeth of these copies), bolting it into the slot at the front of the table, which is used for the automatic knock-off. We found that it was considerably quicker work, and also less liable to make mistakes; but after seeing a lad, who helped with this machine, pressing for all he was worth on the feed-screw handle—I suppose to make sure that the catch was up against the teeth of the copy—we decided to put a ratchet stop in place of the usual handle, on the same principle as the micrometer ratchet stop, so that the pressure on the catch was always the same. Since then we have not had much trouble with our rack-cutting. We can cut 3-pitch gray iron comfortably and 6-pitch steel; 5-pitch in steel just about taxes the machine to its full capacity. I say machine advisedly, as that is the weak place, the attachment being far stronger than either the drive or knee slides. I think any of your readers who have used the ordinary milling machine rack-cutting attachment, and who make one similar to ours, will be gratified with the results as we have been.

RACK.

Is it Right to Accept a Bid That is Too Low?

The recent discussion, whether it is right to do worthless work to order or not has brought to my mind a similar query, but along somewhat different lines. Is it right for a customer to accept a bid for work at a price at which he *knows* the one who is to produce the work will lose money?

Some years ago I gave a price of $190 for a set of dies for a certain purpose. The job had been done in a different way before, and the old dies had been worn out.

The new dies took considerably longer to make than was estimated, and in consequence about $50 was lost on the job. When finished I refused to let the dies go out of the shop till the contract price ($190) was paid, as I was afraid that if they did get out of the shop without payment having been first made some difficulty would be experienced in collecting. This resulted in trouble with my customer, who asserted that the dies were no good and would not do the work. As he had not only passed the dies, but had shipped several large orders to his customers which had been made in my shop with the dies, that excuse would not hold water. Having both the dies and the press and a lien against them, I felt pretty safe when he threatened to sue. On receipt of the threat I stopped turning out the work, and this brought him to his senses, the bill was paid and the press and dies hauled away, he still protesting that the dies were no good.

About a year after this the proprietor of another machine shop came in one day with a package in his hand. In the package was the die I had made, ground down as far as possible. He did not know that I had made the die, and I did not at first tell him so. He had come in to consult me on the best way to do a certain part of the work and to borrow a special cutter for the job. I found out that he had given a price of only $50 for a complete die. Picking up the die I said: "This looks to me like a poor piece of work."

"You are wrong," he replied; "I have orders to copy that die exactly; Mr. X (my customer) says it's the best die he ever had, far better than the die made by B; it has been working night and day for over a year and has been worn out in service."

I then told him I had made the die, and the price I had charged for it. I also pointed out that X knew I had lost money on the job and knew also that no one could make the die at anything but a heavy loss for $50.

Subsequent inquiry of machinist B elicited the fact that the first die cost $350 and was back in the shop for repairs every week or two, owing to its slender construction.

What I contend is this: After seeing me lose money on the job at $190 it was dishonest of X to permit another machinist to make an exact copy of that die for only $50. Am I right? SEA CLIFF.

Making Ink Waterproof—Laying Off Angles Without a Protractor—Gap Lathes.

In looking over some back numbers of the AMERICAN MACHINIST, I came across a letter referring to ordinary and waterproof drawing inks, in which the writer had required a waterproof ink, but found that it was not as dense a black as the ordinary kind.

For the benefit of this gentleman and any others who do not know, I would say that any ordinary ink may be made waterproof by mixing with it a little ordinary glue. The draftsman who told me this said that after waterproofing ink in this way it was possible to wash drawings with soap and water, if necessary, without the ink running at all.

Another little kink which may prove useful to anyone who wishes to lay off an angle when there is no protractor handy, is to remember that ⅛ inch on the circumference of a circle 14.32, say 14 5-16 inches, diameter, equals 1 degree.

Another point which is a very sore spot with me is the layout of properly graded speeds for machine tools, more especially lathes. Of course this becomes a comparatively easy job for such a machine as the American Tool Works Company's high-speed lathe, of which the capacity is given as 1 to 4 inches diameter of work; but it is a different thing altogether when the machine has to be designed for a range of work three or four times as large, the whole range being covered by eight speeds. This occurs in that useful (?) machine, the gap lathe, which, when first made, in the days when one machine was used for as many different jobs as possible, was designed with a gap in order that pulleys, face-plates, etc., might be swung therein for boring; but some deluded idiot conceived the idea of increasing the capacity of the machine by lengthening the cross-slide of the carriage so that the work up to the full diameter of the gap might be machined. The depth of gap is generally the same as the height of centers, so that in an 8-inch center (16-inch swing) lathe, if it be a gap lathe, it is supposed to be possible to machine the face of a 32-inch diameter face-plate.

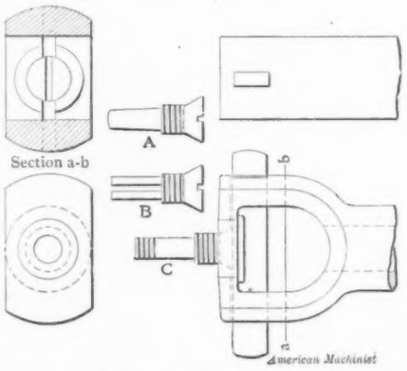
The diameters of the cone for this machine may be 10, 8, 6 and 4 inches, with a back-gear ratio of 11 to 1, so that the increase of speed between two steps of the cone is nearly 2 to 1, while the fastest speed is sixty-two times faster than the slowest. Yet with a countershaft speed of only 100 revolutions per minute, the cutting speed on the 32-inch diameter face-plate will be over 30 feet a minute, and the belt speed 100 feet a minute; so that it may be imagined that no chip guard will be necessary to keep back the flying chips, a greater necessity being for an extra man to stand by and to give the driving belt a little assistance.

I know that a lot of these machines are made simply to sell; but, on the other hand, I know a few firms where all lathes are of the gap variety, who say that they have not enough work to keep even one straight-bed lathe fully employed. Their idea is that they should be able to take nearly any job to any lathe—a very short-sighted policy, indeed. Personally, I think the gap lathe is a very useful tool; but I think the gap ought to be, in depth, not more than three-quarters of the height of the centers, and the speeds provided by the cone and gearing should give a range up to three-quarters of the height of the centers; this would mean a 6-inch bar as a maximum for an 8-inch center lathe. DRAFTSMAN.

England.

A Chuck For Countersunk Head Screws.

The drawing shows a chuck for holding a countersunk head screw without spoiling it. It can be used in the lathe for turning and threading ready-made



CHUCK FOR COUNTERSUNK HEAD SCREWS.

screws, like *A B C*, and also can be used on milling and screw machines or in the vise. This chuck will be useful to all those who have much to do with threading old countersunk and button-head screws or special jobs. Screws of any length can be threaded close to the head, and screws of different sizes can be threaded in the same chuck by changing the bushing.

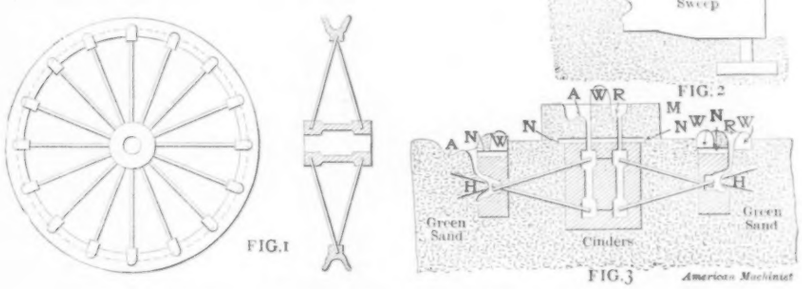
The chuck has a flat head, with an opening for receiving the bushings and work; and there is a hole through the shank for applying large screws, a taper key, holding the screw and bushing. All screws can be put in at the hole by taking out the bushing, pushing the screw into the shank hole, then slipping the bushing over the end of the screw. The bushing is slotted to clear the key and the front edge of the latter touches the screw only.

AUG. LIDOVEC.

Molding a Sheave Wheel With Green Sand Groove and Staggered Spokes.

In filling an order recently for several sheaves, 5 to 12 feet diameter, with a gray-iron rim and hub and wrought-iron spokes from ⅝ to 1⅛ inches diameter, we proceeded as follows. Our aim was to produce the pattern work with as little expense as possible, and yet provide a permanent pattern, or sweeps, in order that we might get almost any number from it. Fig. 1 shows the wheels to be made. A sweep, as in Fig. 2, was provided, which swept at the center, the proper depth after the bed had been properly prepared with cinders, etc. The groove was of green sand—see Fig. 2—and swept up. No attention will be paid to the hooks—Fig. 3 at *H*—for supporting the green sand groove or to the proper venting, as the foundryman will take care of that.

Previous to giving the foundryman the sweeps thus far mentioned, a segment core-box should be made, divided on the arc in such proportion as to make its handling convenient. Also be guided by the diameter of the wheel, so as to divide centrally between the bosses on the rim, where the spokes enter it.



MOLDING A SHEAVE WHEEL WITH GREEN SAND GROOVE.

By reference to Fig. 3, which shows the mold in section, a good idea may be had of how the inside dry-sand core-box should be made. The hub core must be jointed where the lower spokes enter it, and will have to be put in place as soon as the cores that form the rim are ready to be set. Having set every other spoke in the bottom, next place the central portion of the hub core and fill in with sand, so as to support the hub and the rim. Now set the top spokes, then the remaining portion of the central core and the job is fairly completed. A plate *N* should be set over this, having the proper holes in it for the metal to enter the hub from the pouring basin *A*, also for the riser *R*. *M* is an iron ring to hold the sand in.

Now in making the last core for the rim it will be necessary to lay in a strip of tin, cut to suit the curve, on a line with the center of the bosses, in order to get it into the mold.

Cover the rim with a gray-iron plate *N*, provide the necessary holes for the metal to run into the rim from the pouring basin *A;* also for the risers *R*.

The necessary weighting down can be done by using regular gray-iron weights *W*, or by using pig iron—two rows of either will prevent the rim from strain. The rim should be poured a day ahead of the hub, so that the shrinkage at the center may be taken care of. It is a good plan to make sure that the rim is all right before pouring the hub.

There are a few kinks in connection with what has been written about keeping the rim from warping, which come with a little experience in this particular line.

S. B. RYDER.

Copied Inventions.

My question on shop ethics asked so long ago has elicited an answer at last, and while I perceive the logic of Mr. Plaisted's reply (page 603) and have so far, and probably always will, act in accord with his opinion, the way he puts it opens up another point of view. Now, suppose that either he or myself invents something. We would be glad to put it on the market, but we are both poor (we will suppose; I am, sure enough) and it is not easy to enlist capital in a new machine tool, so it has to go past till some capitalist who is rushing madly over the country trying to find a safe haven for his money finds us out. Then again, if we should put everything on the market that we should think of, we would be exploiting new things all the time and there would be no time left in which to gather in the profits. So it is inevitable that inventions shall be made and laid on the shelf. It is equally inevitable that someone else shall invent the same or nearly the same thing, for we all have practically the same previous experience of the world to work on, and our minds all work around in similar circles. Now, if someone else invents this same thing without suspicion that anyone is ahead of him, he will hunt around for capital. Perhaps he won't find it. Possibly he has not that personality which commands trust from moneyed men; perhaps he is ahead of the times; but, too, there is always the chance, which was ours, too, that he will secure the necessary capital. But if he does, is the fact that he has enlisted capital and we have not, to be a criterion as to who is entitled to the profit in the machine? Or is it right that the man who did not succeed in raising money should suffer loss of his rights because another man did raise money? To take a concrete example, which I have no doubt has its parallel in a great many instances, some twelve or fifteen years ago I had a feeling that a cone pulley on a lathe ought to be a back number, so I designed a lathe head with a variable-speed gear not unlike some on the market to-day and not much worse. I took up the matter of its use with some of our agents, but while they all said it was a good thing, they agreed that they couldn't give us any more money for the tool with the new head than with the old, and they wouldn't promise orders anyway. As we were dependent on our agents, it is easy to see that the idea was shelved.

Now, someone will say, "Why don't you patent it?" Well, I have a couple of patents now that are not working. One is being infringed right along by a large concern. I know better than to fight it, for I have a family of my own to feed without taking on a lawyer's. I have seen a patent defined as a license to fight, and that is about all it is in practice. And a patent in the machine-tool line doesn't amount to much. Every important patent that I know of in that line either is already being gotten around by other tool men or can be avoided or voided if anyone wishes to do it. And, as Chordal said long ago, men who wouldn't imitate a good thing will steal a way around the letter of a patent every time.

In the specific instance which I previously cited, neither the other party nor myself have applied for a patent. They have not put it on the market, and don't intend to. They have the capital to do it; I haven't. Their invention of it was undoubtedly entirely independent of mine. Can't Mr. Plaisted give us more light, in view of the circumstances?

ENTROPY.

A Case for Miscellaneous Blueprints.

Every drafting room is called upon to preserve foreign blueprints that have been submitted for the purpose of showing where machinery is going, the uses to which it is to be put, or for divers other purposes. These prints are for the most part for temporary use only, but woe betide the man that throws away even the most evidently useless one, for soon after that print will be called for, and would often be worth its weight in gold to the company.

The problem is, what to do with them. They are of all sizes and shapes, oblong and square, and even irregular. If rolled, the small ones become lost, the large ones crumpled, and after a short time they cannot be laid out flat for examination. I have noticed in several items that these old prints may be soaked and brought out

flat, but my impression is that the writers never tried this with very old prints, as my success in this line has been very poor; besides, many of the prints in question have notations in various inks, that would become illegible when wet.

I have tried putting these prints in large drawers, and found the small prints had a very provoking habit of slipping away to strange places, and the large ones kept their corners up for the purpose of catching in the drawer and tearing off the essential dimensions.

With these various experiences I tried pigeon-holes, of such size that the prints, when folded, are about right for a large envelope, 3¾x10½ inches, and the prints are folded with contents inside to preserve from dust and destruction, and indexed in any approved may, though I prefer a plain numerical system myself. When the case is over the head, put the numbers on the underside; when at usual height, on the upper side. This system even takes care of the small prints, as there is little danger of disturbing small prints when removing others. It takes care of the large prints, as a print on heavy paper, 4x8 feet, can be folded this way with a little practice; it does not make a neat fold, but it answers the purpose. When a large roll of prints or a folio is to be indexed in its entirety, put a card of the proper size in the proper place, stating that the folio whose description is given has been stowed away behind the chest of drawers in the northeast corner of the room.

When these prints are wanted, even if they have become quite ancient, they may be unfolded and the contents examined. Of course they will not lie down flat, but they will not persistently curl up as the rolled prints will.

Another use I have found for a case of this kind is for storing prints which have been made to fill hurry-up calls, such as foundation plans, etc. These prints, being properly folded for mailing, please the mail boy, and save time at the end of the day.

Of course the symbols are placed on the dividing shelves, and, if desired, a stated number can be kept in each pigeon-hole. I have found it convenient to place ten, twenty or thirty in each pigeon-hole, thus numbering the divisions by multiples of ten.

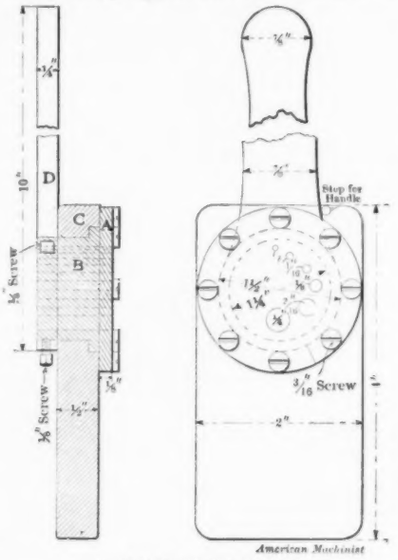
The height should be such as will enable one to pull out all the prints with one hand; about 6½ inches pleases me, and I have found it profitable not to crowd the space full, but to use another hole when necessary. This system permits the storing of a large number of prints in small space, with all available.

In the country, where the air is fairly pure, it is not necessary to have doors in front, as the dirt will not accumulate very fast; and if it does, it can be dusted off. In Chicago, however, I had a large case of this kind made, and found it advisable to enclose it, which was done by sliding doors, running in ways top and bottom, and sliding past one another; four doors being used, allowed access to every portion of the case, the paneling on the doors serving for handling. The fit where the doors lapped by was fairly good and practically excluded all dirt.

These cases can be made of practically any size. The largest that I have had built was about 4 feet high and 12 feet long, and had capacity for about 4,000 prints of assorted sizes. C. J. M.

A Small Wire Shear.

The drawing shows a small shear. I think it quite an improvement since it has no axle. It is made of four pieces, *A* and *B* being of tool steel and *C* and *D* of



A SMALL WIRE SHEAR.

mild steel. It is simple in construction and may be packed in small space. It has six cutting holes and has ample space for more. The holes for large wire should be near the center so as to give greater leverage. J. LIGHTCAP.

Some Proposed Improvements in Small Tools.

I enclose a few sketches of standard tools and offer some suggestions that I think would be an improvement on some of the tools as now manufactured. Fig. 1 is a well known depth gage, but with the stock graduated as shown for determining the distance from the keyway to the edge of hole.

Fig. 2 is a micrometer where the anvil *C* has a thin flange which overhangs about 1-32 inch, and is very useful in taking accurate measurements similar to the one shown in this sketch.

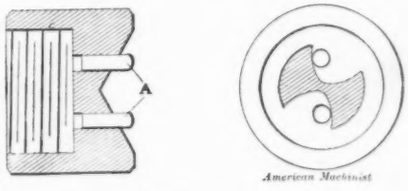
Fig. 3 is a precision punch for laying out precision center work. On the base of this tool there are three faces milled for the three graduations, *B B B*, which are in line with the center and 90 degrees apart. Where the work is laid off with two lines at right angles the center can easily be verified by matching the lines on the tool with those on the work.

At a slight cost a glass could be fitted to the peep hole *A*, adding to the working value of the tool. The shank *D* is straight nurled and the faces are milled with a small cutter 5-16-inch diameter.

GEO. HUBER.

A Chuck For Re-turning Twist-Drill Shanks.

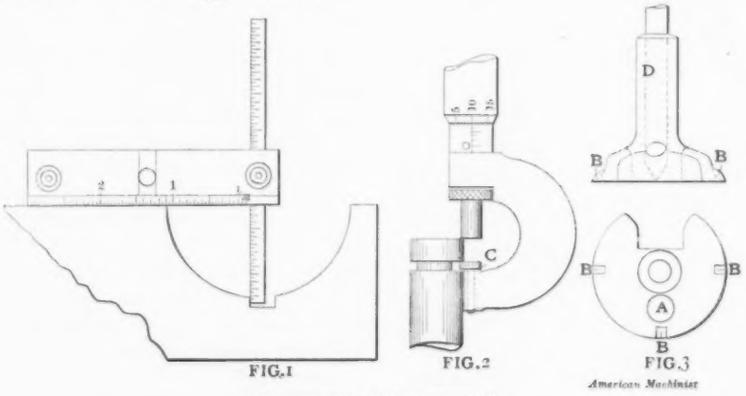
In a tool-room that had not been cleaned out for years a new foreman took charge.



THE CHUCK.

Drills with broken tangs that were still fairly long were centered and turned in the lathe, being held in a female center —shown in the illustration—driven by the pins *A* which engaged with the lips of the drills. By the use of this center, which screwed on the lathe spindle, no time was lost in chucking the drills, their points ran true, and almost every size of drill could be handled with the one center.

D. H. N.



THE PROPOSED IMPROVEMENTS.

Cutting a Gear in a Confined Position.

The gear cutter shown in Fig. 2 was designed to cut blank *A*, Fig 1, in the milling machine. The stock was first re-

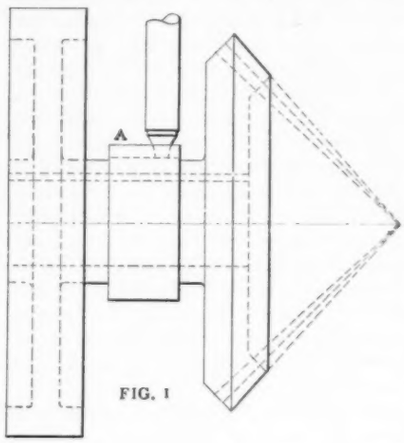


FIG. 1

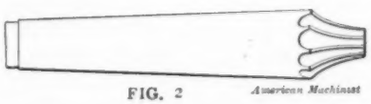


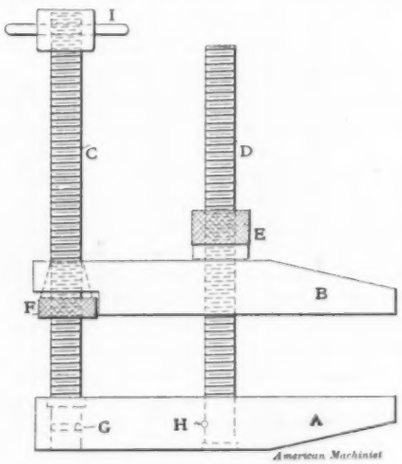
FIG. 2 *American Machinist*

CUTTING A GEAR IN A CONFINED POSITION.

moved with an end mill, after which the finishing mill shown was used with satisfactory results. I. N. QUIRE.

A Machinist's Parallel Clamp.

At page 607, Mr. Patterson shows a very handy parallel clamp. I made a similar toolmaker's clamp like the inclosed sketch, which is much handier. This clamp is self-contained and does not need a wrench. The jaw *A* is counterbored for screws *C* and *D*—the latter a running fit, the former a driving—secured by the steady pins *G* and *H*. The jaw *B*



A MACHINIST'S PARALLEL CLAMP.

is recessed, bored and counterbored for the tapered nut *F* and a rather loose fit for the screw *D*. In operation, adjust both the nurled nuts to your work and tighten up by the handle *I* and the screw *C*. The tapered nut *F* grips the jaw *B* firmly without further aid while tightening by the handle. Both nurled nuts are slightly smaller than the jaws of the clamp, which lies flat with the work. All parts are drawn to scale.

F. L. SANDER.

An Internal Recessing Tool.

In Fig. 1 the smaller diameter of the hole and the tapered portion are to be machined, while the chamber behind is cored. The hole is bored on a horizontal boring machine which has no cross-side, and the difficulty lay in devising a tool which would pass through the hole and still cut the taper without any side adjustment of the machine, and at the same time have the necessary rigidity. It is impossible to get into the chamber from behind as it is closed, and also it is desired that both operations be done with the same chucking. The tool shown in Fig. 2 was made

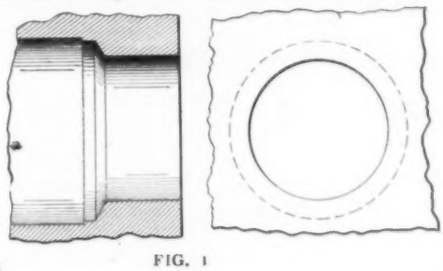


FIG. 1

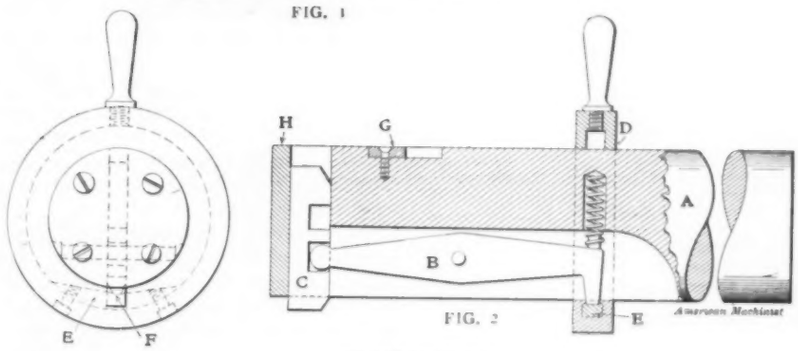


FIG. 2

A RECESSING TOOL.

for the job, and its continued use is evidence of its success.

The bar *A* is slotted at the side to admit the lever *B*, and also on the end a depth and width to allow a neat sliding movement of the tool *C*. The lever *B* is pivoted in the center as shown. The tool *C* is slightly shorter than the diameter of the bar *A*, and is cut out to admit the end of the lever *B*. The tool is made double so that it may be reversed when one end becomes dull. It is hardened all over. Cap *H* is clamped to the end with four screws to keep the tool from falling out.

The ring *D* is deeply grooved on its inside diameter to admit the cam *E*. The cam is held in place by two small screws through the ring, as shown in the end view. It is obvious that the cam must be shorter than the diameter of the bar *A* or else it cannot be gotten into the ring. The spring is used to force the end of the lever *B* out against the cam *E*, and is held in place on the end of the lever by the pin shown. The handle is used to give the ring a rotary motion, thus moving the cam and causing the tool to be projected or withdrawn. The end of the lever which rests on the cam is rounded at *F*, and the cam is grooved in its center to receive it. This gives a decided snap when the lever falls in place, and the operator knows that it is in position for cutting. It will be seen that the cam is not so deep as the groove in the ring, thus causing the lever to always project above the bar and preventing a lateral movement of the ring. The face of the cam is shown straight instead of curved, and it is made that way, although it causes the tool to move forward and then retard before it comes into cutting position, but the cored chamber behind is deep enough to allow for the extra movement.

The tool is not to be fed into the work by the rotary motion of the ring, for this would cause too much spring through the lever. The tool *C* is drawn into the bar *A* and run back into the cored chamber when it is projected and fed out toward the face of the work. The tapered surface does most of the cutting, and as the angle is only 30 degrees there is very little upward thrust of the tool. The flat piece of steel *G* is a gage set into the bar as shown. When this gage comes forward flush with face, which is easily tested by laying a scale across the work, the operation is completed. L. F. B.

Metallic nickel is rendered brittle by the presence of arsenic and sulphur. Iron in the proportion of 1 per cent. and upward is looked upon as objectionable in nickel intended to be used in alloys.

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Wages Not Governed by the Cost of Living.

An instructive incident is telegraphed from Chicago in the form of a story about the representative of the Oil Wagon Drivers' Union, whose members, working for the Standard Oil Company, had asked an advance in wages from $2 a day to $75 a month, and in making this demand their representative furnished figures showing that for a driver to provide for himself and family the ordinary necessities of life, consisting of rent, food, fuel, light and carfare cost him $1.97 a day; and he asked, "Can a driver buy clothing, shoes, pay doctors' bills, buy school books and the other innumerable things needed by a family for three cents a day?"—the income above the cost of the necessities referred to. The local manager of the company confessed that he did not see how this could be done—confessed also that he himself could not live in Chicago for $2 a day—but he said, "The fact is, I can get plenty of teamsters who are willing to work for that pay. That is really what governs wages more than the cost of living."

In this the Chicago manager of the Standard Oil Company uttered an axiomatic, economic truth. Wages are in the end governed mainly by what employers can get suitable men to work for, modified here and there, of course, by the disposition of some employers to pay more than they really have to, and by the complete or partial monopoly established by trade unions; but most of those employers who would, if they could, pay more than they are obliged to pay cannot do so, because their competitors do not, and they must employ their labor at or about the ruling rate or go out of business. And what men will work for is again not controlled primarily by the necessary cost of living, because the standard of living must be, and usually is, modified to conform to the amount which can be earned. Wages are controlled rather by the opportunities which are offered for men to go to work, and as an illustration of this law some recent happenings in Nome are instructive and interesting.

Upon the discovery of gold in Nome, men flocked to the place in the expectation of making their fortunes. At first wages were very high, and were for everybody about equal to what men found they could dig out of the ground in gold. This amounted to something like $6 or $8 per day, and as anyone who chose to do so could dig out about that amount of gold, those who were employed as cooks, or as clerks in stores, or in any capacity whatever, naturally commanded the same wages. They needed no unions to secure them, but the conditions secured that wage automatically, it being well understood that no one would work for another at less than he could earn by working for himself in digging gold. But after a while the gold-bearing ground was all taken up, so that those who would thereafter dig gold had to seek employment of those who owned the places from which it might be dug.

Wages fell to about the normal rates, not only for those who dug gold, but for all others as well. Things went on in this way for some time, until one day a miner who had become tired of the situation, disgusted and determined to quit the country, threw his mining tools into the sea, hoping never to see them again. His pick fell in shallow water and stirred up some sand which attracted the attention of the miner. Upon examination, it was found to be loaded with gold, and thereafter, between high- and low-water marks, miners freely entered, gathered this sand and washed from it the gold which it bore; and, as no title could be obtained to this land below high-water mark, it remained open and free to whomsoever chose to work in it. The result was again that wages rose to the former high level, without union or other influence other than the law of supply and demand. And it was not at all necessary for all to go to digging gold from this sand in order to get the higher wages which again ruled. Some continued to cook, or shave other men, or work in livery stables, or do blacksmith work or whatever they chose that was in demand; but their wages were always at least as much as they could earn by digging gold on the beach. There have been many other proofs that wages, above the cost of mere subsistence, are not governed by cost of living, but by the opportunities there are for men to work, and it is therefore true, as the Chicago manager of the Standard Oil Company said, "It is what other men will work for that governs rates of wages." There is little real utility in tables of comparative cost of living, etc., except as showing the effect of different fiscal policies.

The Policy of Silence.

An incident occurred in Pittsburg a few days ago which throws some light upon the wisdom of the policy pursued by many corporations of not allowing their officers or representatives to talk with anyone or to give out information of any kind regarding the business of the company. The Jones & Laughlins Company, of Pittsburg, had been reported by a Pittsburg paper as having driven a widow from her home where she had lived for forty years, and of demolishing her house during her absence; the accounts presenting the action of the company as having been brutal in the extreme and entirely without regard to the rights of the widow. No one connected with the company would say anything about the matter one way or the other, and, naturally, a good many prominent citizens here in New York and elsewhere assumed the substantial correctness of the report, took up the matter and contributed money for the purpose of fighting for the cause of the widow. Finally,

there was so much agitation that the Jones & Laughlins Company apparently felt compelled to issue a statement of the case, which was prepared by its lawyer, and according to which it transpired that the company had acquired legal title to the property by purchasing the interest of various children, the widow having only a third interest for life in the property, and not therefore in a position to retain possession of it under the laws of Pennsylvania; so that, according to the statement finally made, the action of the company was entirely within the law.

There will be those who will say that Mr. Gilder, editor of the *Century Magazine*, and others who took up the matter, were not justified in doing so, and that they have indulged in "hysterics" without cause. We do not agree with that view of the matter. Assuming the account as published in the Pittsburg paper to be correct, it was a matter of concern to every American citizen, and those who became interested in it did a thing which reflects credit upon them. And so long as there was no denial or explanation of the matter by anyone representing the company referred to, and officers of the company to whom questions were addressed refused to say anything about it, there was nothing to do but to assume the correctness of the report. We are all more or less accountable to public opinion in this country, and it won't do for even large and important corporations to disregard that fact; their doing so not only injures the ones who do it, but all other corporations as well.

We hear a good deal these days about "men who do things," apropos of which it has been remarked that "the various State prisons are full of men who are there for doing things." We are reminded of this by a remark made in a recently published book entitled "Letters from an Old Railway Official to his Son, a Division Superintendent." The old man is supposed to be giving his son advice upon various things connected with the conduct of a railroad; and in discussing the matter of what to do when there has been a wreck, he tells him of some things which are sometimes done but which ought not, he thinks, to be done, and concludes by saying, "Men often earn big salaries by the things they avoid doing." This, of course, is just as much true as that they earn big salaries sometimes for the things which they do, the fact being of course that the big salaries are earned by the men who do the right thing, or as near the right thing as possible, and avoid doing the things which are wrong or ill-judged, and the latter is often the more important. Opportunities for men in responsible positions to do wrong things are absolutely unlimited, and there are usually an abundance of advisers and others who, from interested motives, try to have these wrong things done. The efficient manager has good judgment and is guided by it.

New Tools and Machine Shop Appliances.

METAL SAWING MACHINE.

The metal sawing machine shown herewith has been designed with a view toward great rigidity and absence of lost motion in the ways, the spindle and the feed, the appearance also having been studied so as to produce a neat and well-proportioned machine.

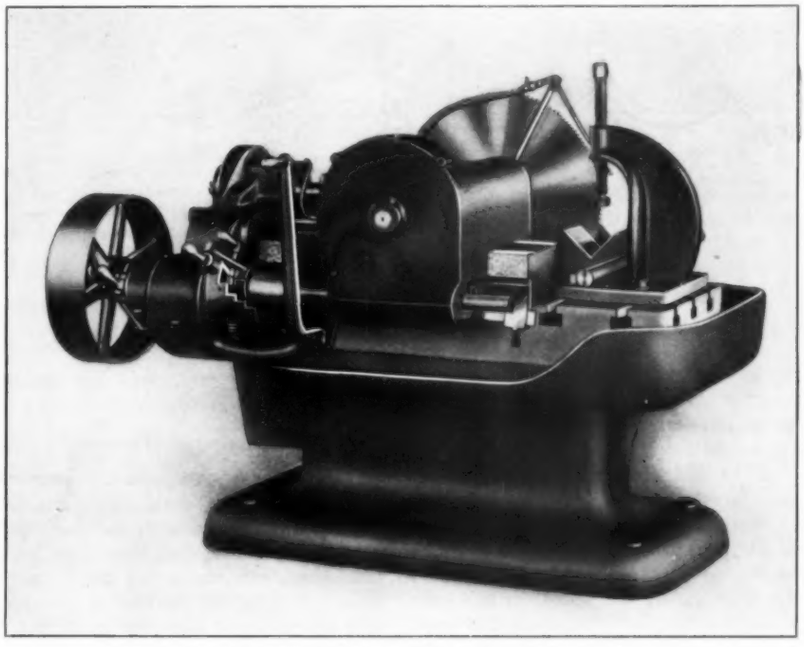


FIG. 1. METAL SAWING MACHINE.

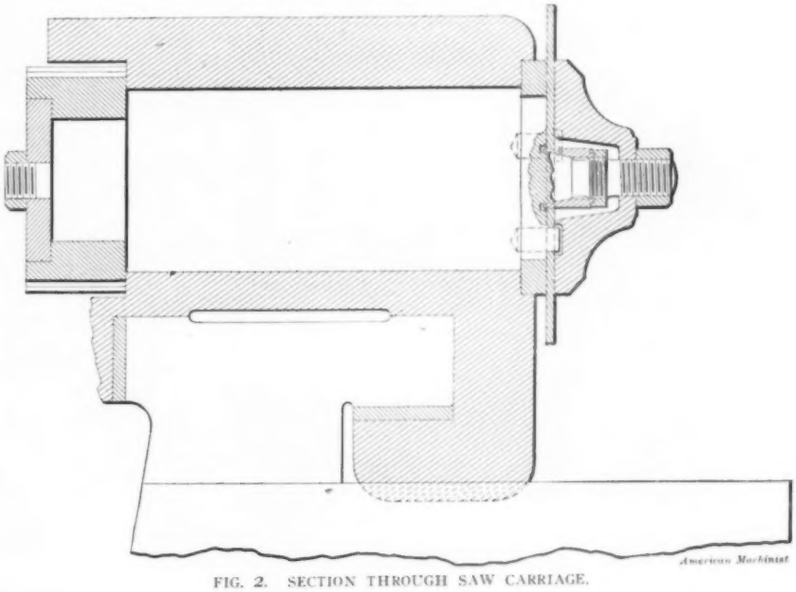


FIG. 2. SECTION THROUGH SAW CARRIAGE.

Among the new features is the carriage which is solid under the ways at the saw end of the arbor where the strain is upward, and is fitted with taper gibs, the under gib on the opposite side having, however, been omitted as it has been found unnecessary. Fig. 2, which is a section through the carriage supporting the saw arbor, shows this construction. The arbor is of large size, is case-hardened and ground and runs in a solid bearing. This eliminates all lost motion between the bed of the machine and the saw.

Another feature is the mounting of the saw, in which is used an expanding bushing (seen in Fig. 2) on the tapered end of the saw spindle, centering the saw perfectly so that thorough tests have failed to show any time when the saw did not cut uniformly throughout its revolution. Fig. 3 is a detail of the bushing and Fig. 4 of the nut which expands it.

The feed screw is made extra large and is placed as near as posible directly back

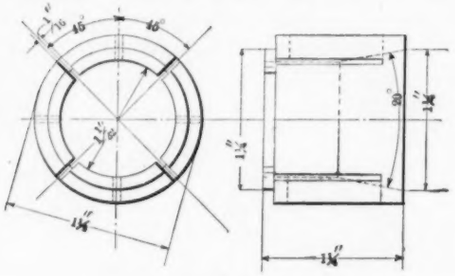
of the saw; the screw and its nut are of the same length and the nut is split, allowing all slack to be taken up. The feed screw is driven through a worm and wheel by a cone of gears giving five changes of feed, the following being the respective amounts per revolution of the saw: 0.074, 0.112, 0.149, 0.186 and 0.224 inch. The amounts of carriage travel per minute corresponding to these respective feeds are, with direct spindle drive, ½, ¾, 1, 1¼ and 1½ inches, or, with the back gears in, 9-32, 27-64, 9-16, 23-32 and 27-32 inch. An automatic stop cuts out the feed and returns the carriage for another cut.

The spindle is driven by a pair of steel spur gears through a large gray-iron worm-wheel and a case-hardened triple worm of coarse pitch. The back gears with which the driving shaft is provided have a ratio of 9 to 16, giving two speeds of this ratio to the spindle. The speed of the worm shaft, direct driven, is 192 revolutions per minute; back geared, 108 revolutions. The saw runs 6.7 revolutions with direct drive, 3.8 with back gears. The corresponding circumferential velocities for a 20-inch saw are 35 and 20 feet per minute, respectively.

A generous drip pan is furnished, which returns all the oil to the tank at the back of the machine. A positive pump, which requires no priming, furnishes an abundant supply of oil to the saw.

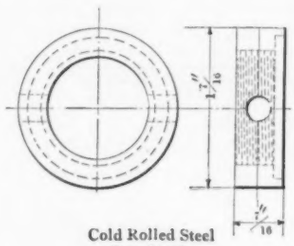
The work-table is provided with T-slots for holding any kind of vise for special work; the work may also be strapped directly to the table and the full section of the saw outside of the collars may be utilized. A vise for ordinary round or square stock is furnished, also a stand to support the free end of the stock.

This machine is designated their "No. 5" by its manufacturers, the Cochrane-Bly Company, of Rochester, N. Y.



Steel, Harden & Grind to Gauge

FIG. 3



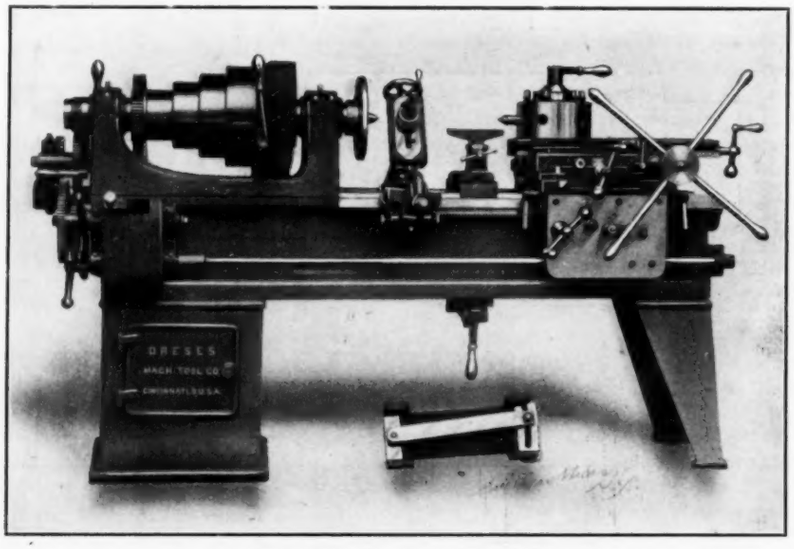
Cold Rolled Steel
Case Harden

FIG. 4 *American Machinist*

METAL SAWING MACHINE.

20-INCH FULL UNIVERSAL MONITOR LATHE.

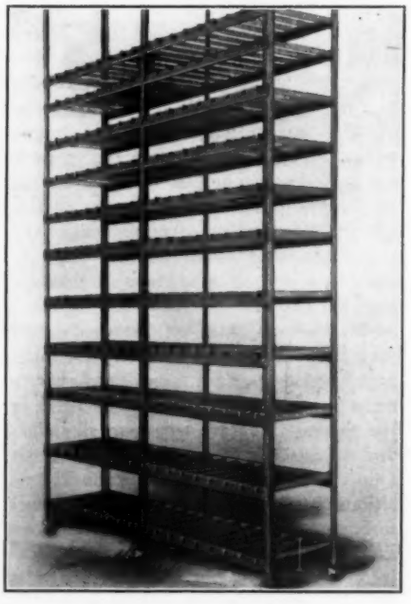
This machine is designed for general brass and similar work of special and heavy character, and with the object also to permit manufacturing operations to be carried on economically without special tools. The turret carriage is provided with an automatic feed similar to that of an engine lathe, and the coarsest four leads are 8, 11½, 14 and 18 per inch, corresponding with the standard pipe threads. This arrangement not only avoids stripping of threads in large tapping, but also inside and outside, straight and taper threading can be done by a turret tool without tap or die. There are twelve changes of feeds, multiples by 3 and 6 of the four coarse feeds given above. Four changes of feed can be made instantly by a handle located below the headstock, and the reverse is made by a knob at the front of the apron. Interposed between the lower and upper part of the turret carriage is a double dovetailed plate, to the lower side of which is swivel-connected a shoe which slides on the bar of the taper attachment shown under the machine. The frame of this taper attachment slides between the Vs of the bed and the bolt clamping the guiding bar also holds it in any position longitudinally. The whole arrangement can be readily removed when not used. The upper part of the intermediate dovetail plate has a screw with ball crank-handle for cross-feeding by hand, and screw-clamping stops are provided for setting the turret holes in line with the spindle. The turret slide is provided with pilot wheel and screw movement. The turret rotates on a stem with adjustment for wear, and the locking pin withdraws at the return movement of the top slide, making it semi-automatic. The machine is equipped with the usual chasing bar, and the follower-holder is yielding for taper work. Right- and left-hand threads can be cut without changing the leader. The headstock is friction back-geared and has a four-step driving cone. The spindle has a 1 13-16-inch hole clear through, and a wire feed can be easily applied. The cabinet support under the head is provided with tool shelves and the leg at the other end is hinged to form a three-point support. The machine weighs about 2,900 pounds, and is built by Dreses Machine Tool Company, Cincinnati, Ohio.



FULL UNIVERSAL MONITOR LATHE.

AN ALL-STEEL RACK.

This rack, being made entirely of steel, is fireproof. It is also clean, there being no place for lodgment of dirt. The labor



AN ALL-STEEL RACK.

on it is chiefly press-work, so that the rack can be furnished for about the same price as a wooden rack, which is always a source of anxiety in case of fire. When used for holding small work the shelves are covered with sheet iron. The separate pieces are punched so as to lock together, so that when the rack is shipped it is sent knocked down and all pieces marked how to go together. Excepting for a few bolts to hold the main frame together a man's hands, with perhaps a hammer now and then, are all the tools necessary to assemble it. They are made to any special size and for all purposes, by F. E. Wells & Son Company, Greenfield, Mass.

DOUBLE-AXLE CUTTING-OFF AND CENTERING MACHINE.

The Fawcus Machine Co., of Pittsburg, Pa., has recently redesigned its double axle cutting-off and centering machines which it has been manufacturing for some years, and illustrations of the new machines recently built for the American Locomotive Works are here shown. The appearance of the machine is not materially changed, but the various parts have been modified so as to make the machine practically indestructible and capable of sustaining the abnormal strains consequent upon the use of high-speed steel.

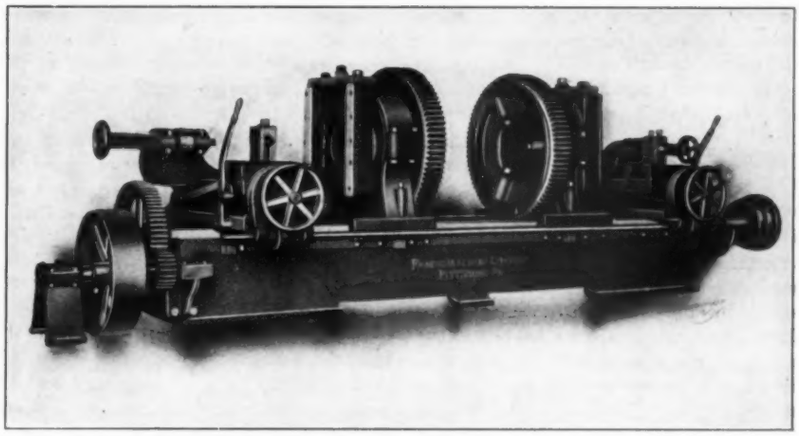


FIG. 1. DOUBLE-AXLE CUTTING-OFF AND CENTERING MACHINE.

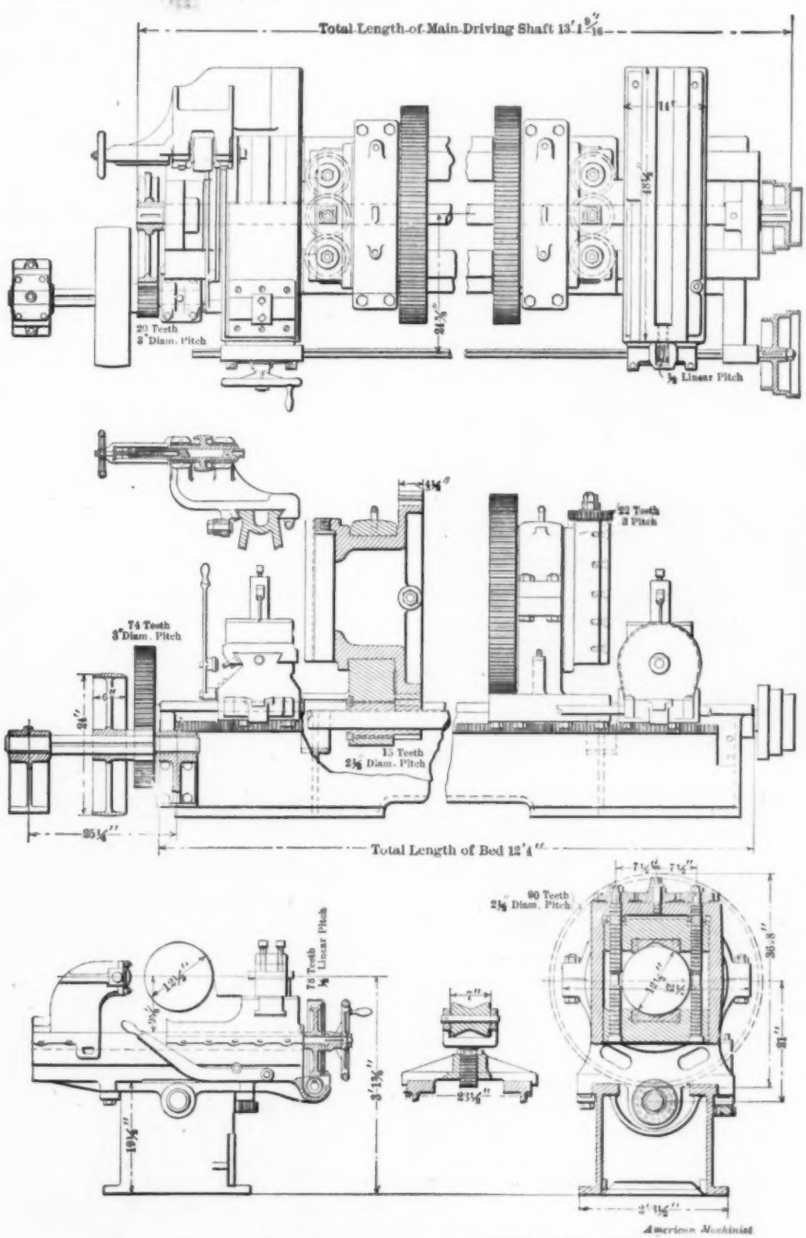

Total Length of Main Driving Shaft 13' 1 9/16"
21 Teeth 3" Diam. Pitch
1/8 Linear Pitch
74 Teeth 3" Diam. Pitch
22 Teeth 3 Pitch
15 Teeth 2 1/8 Diam. Pitch
Total Length of Bed 12' 4"
90 Teeth 2 1/8 Diam. Pitch
78 Teeth 1/8 Linear Pitch
American Machinist

FIG. 2. DOUBLE-AXLE CUTTING-OFF AND CENTERING MACHINE.

The machine consists of a bed carrying two main headstocks, two tool carriages and two centering drills. Power is applied to a splined shaft running in bearings through the center of the bed. Steel pinions movably splined to this shaft mesh in ring gears on the headstocks. Each headstock is provided with a two-jaw self-centering steel chuck, operated by right- and left-hand screws, by means of gears. The headstock bearing is very large and is scraped to a perfect running fit.

The platen, or main slide fitted to the bed of the machine, carries the cutting-off slide and tool-holder on its front end and on its rear end the centering drills, each being gibbed to the main slide.

The feed mechanism is driven from the main driving shaft by a belt and cone pulleys to a splined feed-shaft carrying bronze worms engaging with steel worm-wheels. A hand-wheel on the screw of the tool carriage engages with the worm-wheel by means of a clutch, enabling the operator to adjust the tool before applying the power feed.

In operating the machine, a roller on an adjustable stand, not shown in the half-tone, is set on each end of the bed so as to guide the rough axle through the headstock. The chucks are then made to grip the axle and the machine started. Half through the cutting operation, which progresses simultaneously at each end of the shaft, a second speed is thrown in, accelerating the machine. Other methods for this purpose may be used, such as the application of variable-speed motors, etc., but it has been found that where these machines are used to their fullest capacity,

the two speeds with the immense power applied to the machine are preferable.

The ends being cut off, by one motion of the lever the centering drill is brought into exact position, and with one or two turns of its hand-wheel the final operation is accomplished.

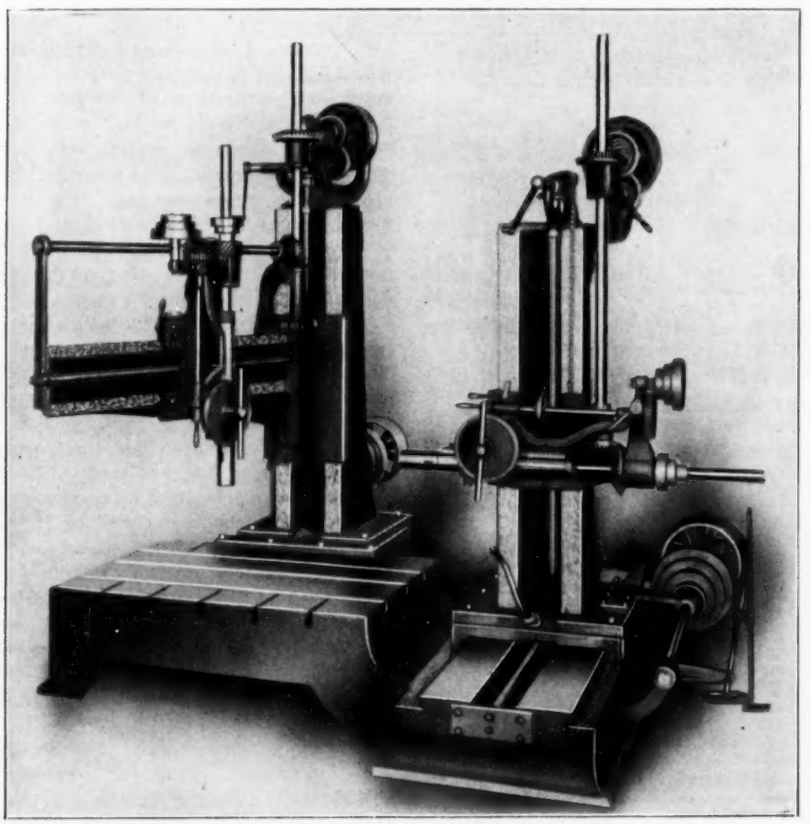
As before stated, no attempt has been made to depart from the conventional type of machine used for this purpose, but every effort has been made to make it more efficient and more durable. All gears throughout the entire machine are made of steel, most of them cut from solid forgings, with the exception of the ring gear around each headstock, which is made of gun iron. The headstock gear is shrunk and keyed onto the headstock, so that in case of necessity it may be readily renewed.

The chucks and tool-posts are of forged steel, the former being fitted with hardened tool-steel inserted jaws. The hardened plate is fitted to the tool carriage so as to obviate excessive wear from the shank of the tool. All bearings, including the loose pulleys, are fitted with phosphor-bronze bushings. As may be seen by an examination of the cut, the parts are very heavy and substantial. The jaw opening has been increased to 12½ inches and the bed to take in an axle of 10 feet in length. The racks and pinions for moving the heads and carriages have been placed in front and are operated by means of a wrench in front of each head or carriage. The feed screw and nut in the centering head are now covered and entirely protected by a plate which is screwed on the arm of the centering head.

The machine illustrated is driven by a single belt; the countershaft having two speeds. If desired, it may be arranged for a motor drive. The centering heads are driven from an overhead countershaft.

A COMBINED HORIZONTAL AND VERTICAL DRILLING AND BORING MACHINE.

The cut herewith illustrates a combined horizontal and vertical drilling and boring machine for use where holes are to be drilled in the ends of long bars or columns, and in heavy castings that require holes in different places at right angles, both horizontally and vertically, within the capacity of the machine and without changing the work on the table.



COMBINED HORIZONTAL DRILLING AND BORING MACHINE.

The table is provided with T slots, and work may be bolted on it and holes may be drilled parallel to one another, both vertically and horizontally. The table, as shown in cut, is 33 inches wide and 48 inches long.

The column with the horizontal spindle has a horizontal movement of 46 inches on the base, and its spindle has a horizontal automatic feed of 16 inches. The spindle head has a vertical movement of 40 inches and is counterbalanced and raised and lowered by a screw.

The column with the vertical spindle is stationary on the base, but has a radial arm on which the spindle has a horizontal movement of 30 inches and the radial arm has a vertical movement on the stationary column of 28 inches. The spindle itself has a vertical automatic feed of 16 inches. The radial arm is counterbalanced by a weight in the column and is raised and lowered with a screw; the spindle head on the radial arm is also moved by a screw.

Each spindle is driven with a separate belt from the line shaft and may be operated independently of the other. Both machines have four step cone pulleys, and by the application of back gearing eight speeds may be obtained by each spindle.

This machine is built by the Hoefer Manufacturing Company, Freeport, Ill.

New Publications.

"A Pocket-Book of Mechanical Engineering." By Charles M. Sames. 168 4x6⅝-inch pages, with 38 illustrations. Published by the author, Jersey City, N. J. Price, $1.50.

The author of this book has endeavored by compression of the treatment of various topics to produce a pocket-book of a size which would make it such in fact as well as in name. His presumption is that an engineer, being familiar with the subject in hand, needs a pocket-book for such things only—formulas, constants, etc.—as cannot be retained in the memory. The work of compression has been well and judiciously done, and the book should serve a useful purpose. Some recent subjects, such as reinforced concrete, ball and roller bearings and high-speed steel, and the inclusion of the latest obtainable data on others, make the book fresh and up to date.

"The Machinist's and Draftsman's Hand Book." By Peder Lobben. 438 5½x7½-inch pages, with numerous illustrations and tables. The D. Van Nostrand Company, New York. Price, $2.50.

The nature of this book will be gathered from an account of its contents, which include brief chapters on arithmetic and algebra, tables of squares, cubes, roots and reciprocals, logarithms, weights and measures, geometry, trigonometry and trigonometrical tables, mensuration, strength of materials, mechanics, belts, wire-rope transmission, shafting, belts, pulleys, flywheels, gear teeth, screw threads, etc.

"Modern Locomotive Engineering." By Calvin T. Swingle. 630 5x6½-inch pages, with 265 text cuts and 35 inset folded plates. Frederick J. Drake & Co., Chicago. Price $3.00.

This is an excellent book designed for the education of firemen in the machine which they all expect ultimately to operate. It is well and clearly written and fully illustrated. As befits such a work at the present day, it is especially full in its chapters relating to piston valves and compound locomotives.

A publication called the "American Wire Rope News" is the latest addition to technical or trade literature. The new journal, as its name indicates, is devoted to setting forth the various uses of wire rope, including the transmission of power, and a perusal of its pages is likely to give one new ideas of the extent of the application of wire ropes to industrial purposes. It is published by the American Steel & Wire Company, The Rookery, Chicago, Ill.

Personal.

H. F. Frasse, late a director and officer of the Frasse Company, of New York, has resigned and has engaged with the Fairbanks Company, of New York.

G. P. Altenberg, of Cincinnati, Ohio, who, for some years, has been the foreign business representative of the J. A. Fay & Egan Company, and has been instrumental in building up a large business abroad for that company, has resigned his position, and it is understood will go into business for himself.

J. W. Carrel has connected himself with J. J. McCabe, 14 Dey street, New York, machinery merchant. Mr. Carrel is well known in the machinery trade, having formerly been with Hill, Clarke & Co., Boston, and later president of the Draper Machine Tool Co., Worcester, Mass., until that company was absorbed by the Whitcomb-Blaisdell Machine Tool Company.

The 1st of November the Power Improvement Company, incorporated, took over the agency relations and business of George P. Dravo, of Milwaukee, Wis., and will continue to look after the interests in the Northwest of the De Laval Steam Turbine Company and the Foster Superheater. Associated with Mr. Dravo will be Andrew Pinkerton, of the American Sheet & Tin Plate Company. Mr. Pinkerton is a member of the American Institute of Electrical Engineers, the American Electro-Chemical Society and the American Society of Mechanical Engineers.

George Moores, secretary of the British Weights and Measures Association, an association which we have often referred to as having been organized for the preservation and the decimalization of the English standards of weights and measures, is in this country investigating the situation here; his chief object, as he states it, being to bring about, if possible, concerted action by this country and Great Britain—a meeting of representative men, or something of that sort, by means of which the preferences with regard to this and to the adoption or rejection of the metric system may be arrived at, and that the two countries may stand together in this matter as against the rest of the world. Mr. Moores' address while in this country is at the Collingwood Hotel, New York city.

Manufacturers.

Walter H. Craig, Chester, Pa., will install an ice-making plant.

The city of Plainfield, N. J., will have a municipal water plant.

The Century Iron Works, Des Moines, Iowa, will erect a new factory.

The Central Stamping Company, Newark, N. J., is enlarging its plant.

The Potthoff & Fry Iron Works, Cincinnati, O., will erect a new structure.

The United Railways Company, St. Louis, Mo., has prepared plans for new car shops.

The plant of the Arcadia (La.) Electric Lighting Company has been destroyed by fire.

The Rockland Electric Company, Hillburn, N. Y., is having an addition built to its plant.

Milliken Bros., New York, will soon begin work on its new steel plant on Staten Island.

Fire destroyed the structural iron works of T. H. Brooks & Co., Cleveland, O.; loss, $100,000.

The Shaw-Kendall Engineering Company, Toledo, O., has awarded the contract for its new plant.

The Mark Manufacturing Company will build another addition to its pipe works in Zanesville, O.

The plant of the Riverside Bridge Company at Martins Ferry, O., was destroyed by fire; loss, $200,000.

It is reported that the Pullman Car Company, Chicago, Ill., will spend $5,000,000 in enlarging its works.

It is said that the Otis Elevator Company, New York, has acquired some more land and will build a new plant.

The West Haven (Conn.) Manufacturing Company, hack-saws, etc., has had plans prepared for an addition to its plant.

The Andrew Terry Company, Terryville, Conn., is erecting an addition to increase the capacity of its annealing department.

The Viscoloid Company, Leominster, Mass., will build an addition to its plant and install also a complete electrical power plant.

The Columbia (S. C.) Gas Company has commenced the erection of a new plant, to be equipped with the most modern machinery.

The Winswell Milling Machinery & Mining Company has been incorporated at Salt Lake City, Utah. Joseph W. Morrison, president.

The Washburn Company, Minneapolis, Minn., will establish a plant for the manufacture of steel castings in connection with its coupler plant.

The Union Computing Machine Company, Trenton, N. J., will erect a new plant, increasing the capacity. This will include a brass foundry.

In our issue of November 2 we published an item to the effect that the National Reed Company, Manchester, N. H., would erect a factory. This should have been the National Reeb Company.

G. W. Summers, secretary of Water-Works Committee, Albeville, La., will receive bids up to 3 P. M. Monday, December 18, for a water and light plant.

The American Car & Foundry Company, New York and St. Louis, contemplates enlarging its plant and building a new one for the manufacture of steel cars.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Punches & dies. Wal.M.Wks.,Waltham,Mass.

Wire and sheet metal working machinery and tools. Emmons Collins, Chicago, Ill.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Working drawings Experimental work. Geo. M. Mayer, M. E., 1131 Monadnock, Chicago, Ill.

Concern making special machinery desires contract for further business. Address Box 846, AMERICAN MACHINIST.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Make us your factory.
Specialties and machinery built to order. Close work; close prices, "Moderate," AM. M.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted—One Brown & Sharpe second-hand automatic screw machine, No. 0; also one No. 2. Address, giving time they have been in use and character of work they have been making, also price, George W. Dover Company, Providence, R. I.

Tool Catalogue No. 22. 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

We want built for us a large number of special traction engines to our specifications and drawings, and desire to correspond with a manufacturer who has large and available facilities for such work. An order for ten would be placed at once, with more similar orders to follow. Terms cash. Please address "X and Y," care AMERICAN MACHINIST.

For Sale.

At Sacrifice—Three 4x36 in. Horner wet tool grinders, first-class condition; also two 2 in. cut-off machines. F. A. Law Machine Co., Hartford, Conn.

For Sale—10-ton crane, 40 ft. span, rope drive; has been tested to 20 tons; very low price for cash. Address Murray Iron Works Co., Burlington, Iowa.

Inventors have for sale the U. S. patent of a diamond-holder. Advantages: No resetting, diamond cannot be lost, all points can be made use of. Best offer accepted. Box 865, AM. M.

Business Opportunities.

Four patents, 25 claims; sewing machine; reverses at full speed; great time-saver; want to place on royalty, or sell. "Inventor," 420 West 22d st., New York City.

Wanted—Partner, practical machinist, who can take charge of manufacturing, marine gasoline engines and specialties; good opportunity to right man in shop or office. "Manufacturer," Box 868, AMERICAN MACHINIST.

A prosperous foundry and machine works in Atlanta, Ga., desires to arrange with manufacturers or patentees for the right to manufacture staple artices of steel and iron suitable for sale in the South. Box 787, AM. M.

Wanted—Practical accountant and business man as treasurer of an established manufacturing business; must be able to show a successful record as accountant and office man, and invest from $5,000 to $10,000 in stock of company. Address, with full particulars of experience, ability and references, "J. B.," care AMERICAN MACHINIST.

Wanted—An experienced foundryman to join others in the purchase and operation of an established job foundry with an assured tonnage of 100 to 150 tons per month; must be able to show a successful record and invest from $5,000 to $10,000. Address, with full details of experience in mixing metals, managing help, references, etc., "G. P. M.," AM. M.

For Sale—Fine tool business, incorporated in Pennsylvania, for $15,000. Goods sold principally by mail. Will sell one-fifth interest, or more, for cash; balance can be paid out of earnings. Will give entire charge, as advertiser has not time to give it proper attention. This is a splendid opportunity for a practical young man to get into a growing and good paying business. Address "Business," care AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines ac-

cepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

General manager, with large experience in organizing new and old manufacturing plants in United States and Canada, is open for engagement; technical graduate; age 35. Box 798, AMERICAN MACHINIST.

CONNECTICUT.

Machine shop foreman, open for position after January 1; thorough, practical, reliable, and with proven ability. Box 848, AM. MACH.

All-round tool and die maker wants position, caring for special machinery or press work; steady and competent; capable to take charge. Address Box 886, AMER. MACHINIST.

ILLINOIS.

A mechanical draftsman, technical graduate, with drafting-room and shop experience, wants a situation. "O. R. A.," Lock Box 581, Peoria, Ill.

INDIANA.

Superintendent; age 35; practical machinist; natural ability and wide experience handling men and reducing costs. Box 713, A. M.

MASSACHUSETTS.

Foundry foreman, of 20 years' experience as foreman of large foundries doing principally loam and dry sand work, desires change; can bring best possible references. Box 875, AMERICAN MACHINIST.

An iron foundry superintendent or foreman, of experience and ability, now employed, wishes to correspond with parties wishing to engage such a party; heavy machinery, engine, press and architectural, and building castings; mixing iron by analysis, loam, dry and green sand. Box 864, AMER. MACHINIST.

NEW JERSEY.

Experienced machinist, with push, and good shop mathematics, wants to change; N. E. Pennsylvania preferred. J. S., care Mr. Lamb, 525 Monmouth street, Jersey City, N J.

NEW YORK.

Draftsman, experienced general, special machinery; New York or New Jersey preferred. Box 877, AMERICAN MACHINIST.

Superintendent, good executive and business abilities, expert mechanic, will consider proposition of $4,000 a year; can make your plant pay Box 882, AMERICAN MACHINIST.

Purchasing agent very large Eastern machine and engine works desires change; irreproachable character, capable, experienced, energetic. Box 870, AMERICAN MACHINIST.

Young man, first-class designing draftsman, machine shop experience, knowledge of patternmaking and foundry practice, desires position as assistant to superintendent of manufacturing firm. Box 878, AMER. MACHINIST.

Position as superintendent or manager, by good executive and organizer, familiar with modern shop methods, premium and other systems of paying labor; experienced on electrical machinery, engines, boilers, etc., also foundry practice; present position general superintendent. Box 879, AMERICAN MACHINIST.

Position as superintendent; experienced and competent in pattern foundry and machine shop; good executive and organizer; well up in labor-saving appliances and modern manufacturing; can produce results; now holding position of responsibility; good reason for seeking change; references. Box 842, AM. M.

OHIO.

Position wanted by a first-class metal pattern maker; understands all branches thoroughly, as well as molding machines. Box 874, AMERICAN MACHINIST.

Mechanical draftsman and designer on special machinery, jigs and fixtures; have had technical and practical training; can make power plant layouts. Box 880, AMER. MACH.

PENNSYLVANIA.

Chief draftsman, general work, wants position. Box 869, AMERICAN MACHINIST.

I have had 12 years' experience in mechanical lines, in office, drafting room, shop and selling; have good knowledge of advertising and human nature. I am not looking for glory or a cinch, but want the easiest job at the largest salary; advertising or sales manager preferred. Can make good, so don't hesitate to bid for my services. Address Box 884, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

General foreman, reliable, 36, experienced in high-grade duplicate general and mill machinery, expert machinist, wishes to make change; Pacific States preferred. Box 883, AMERICAN MACHINIST.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Cost-clerk, for a manufacturing concern in Canada, employing about 500 men; must be able to improve, if necessary, the system in use at present and to take complete charge of the cost department; applicants, to receive consideration, must state age, experience, present place of employment, salary required and when could engage. Address Box 847, AM. M.

CONNECTICUT.

Toolmakers wanted; a number of first-class men for high-grade fixtures, jigs and small-tool work; steady employment. Box 855, AMERICAN MACHINIST.

Diemakers wanted; experienced hands on punching and piercing dies for small brass and steel work; steady employment. Box 854, AMERICAN MACHINIST.

Wanted—A young man, familiar with drafting, to assist superintendent in an iron casting plant; good opportunity for advancement, if capable. Box 856, AMERICAN MACHINIST.

Wanted—A competent mechanical man to act as assistant to foreman for manufacturing typewriting machines, working on the interchangeabe system, and familiar with up-to-date methods. The Blickensderfer Mfg. Co., Stamford, Conn.

Several first-class, all-around machinists are wanted by firm manufacturing elevators, clay-working machinery, friction clutches, etc.; men capable of doing erecting or repair work when required; steady work for right men. The Eastern Machinery Co., New Haven, Conn.

GEORGIA.

Southern manufacturing concern desires services of competent machine shop foreman; must be well acquainted with modern shop methods and practice, also sober and thoroughly reliable; do not want man with union affiliations; good permanent position to right party. Address "Southern Manufacturer," care AMERICAN MACHINIST.

ILLINOIS.

Draftsmen.—We have positions now open for draftsmen. Call or address Western Electric Co., Chicago, Ill.

Wanted—Machine shop foreman; one familiar with hoisting machinery; good salary for good man. Address "B W.," care AM. MACH.

Wanted—A mechanical engineer to teach machine-shop work in Chicago school, also a mechanical engineer to teach woodwork. Address 5738 Washington ave., Chicago.

Wanted—Experienced designer of large multiple-unit engines for electric lighting and general power purposes, using gasoline, producer gas, etc., for fuel; give full information as to qualifications and salary desired. Box 871, AMERICAN MACHINIST.

INDIANA.

Help Wanted.—Large concern in Middle West, with rapidly increasing business and in process of reorganization, with foundry, machine shops, sheet metal, automobile, woodworking and millwright departments, desires applications from executives, foremen, draftsmen, cost and production clerks and skilled mechanics; none considered but those accustomed to modern organization methods; state experience and salary expected. Address Box 831, AMERICAN MACHINIST.

IOWA.

Wanted—Competent tracers. Murray Iron Works Co., Burlington, Iowa.

MASSACHUSETTS.

Machinists Wanted.—We are increasing our force and need good, all-round men on special automatic machinery and jobbing. References as to character and ability required. Apply to L. F. Fales, Walpole, Mass.

Wanted—Foremen for brass-finishing department of factory in Cambridge, Mass.; must be experienced, a believer in piece work and capable of turning out goods at a profit. Address A. T. H., P. O. Box 5077, Boston, Mass.

MICHIGAN.

Wanted—A first-class diemaker who thoroughly understands making dies for drop forgings; state experience and wages wanted. Bown Machine Co., Ltd., Battle Creek, Mich.

Wanted—3 or 4 first-class, A1 automatic screw machine hands; to experienced men will guarantee steady position and highest rate of wages. Answer, with reference, to Box 85, Detroit, Mich.

NEW JERSEY.

Wanted—A first-class mechanical draftsman; state experience and salary wanted. Box 881, AMERICAN MACHINIST.

We are increasing our works and want applications for machinist foremen and machinists; in reply give details of experience, age and wages expected. The Edison Portland Cement Co., Stewartsville, N. J.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Several first-class diemakers on high-grade work; sub-press diemakers preferred; steady work and good wages for good workmen; no labor trouble. Sloan & Chace Mfg. Co., 297 Washington st., Newark. N. J.

NEW YORK.

Wanted—Bright young men with mechanical inclinations, to become machinists in special line. Address Box 800, AMER. MACH.

Wanted—Several first-class toolmakers on dies, jigs and special fixtures for small machine manufacture. Send references to Drawer No. 7, Syracuse, N. Y.

Wanted—First-class tool or die makers on small blanking, forming and drawing dies; none but sober, competent men need apply. Address P. O. Box 196, Albany, N. Y.

Wanted—Draftsman, experienced in design of jigs and fixtures, also dies for light interchangeable work; state experience and terms. Address Box 873, AMERICAN MACHINIST.

Wanted—A young man with some experience in buying mill supplies, iron, steel, fittings, pipe, valves, etc. Apply to or address Room 302, 114 Liberty st, New York City.

Machinists for floor work; must be first-class men who will appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 859, AMER. MACHINIST.

Wanted—Experienced draftsmen, first-class machinists, toolmakers, and gauge makers; give detailed experience, references, age and wages expected. Remington Arms Company, Ilion, N. Y.

Bright young mechanic, familiar with small fine work, to learn to care for some special machinery in a manufacturing plant; will pay $20 per week, or better, to satisfactory man; non-union preferred. Apply to Box 799. A. M.

Wanted—Foreman to take charge of machine shop; one that is thoroughly up in modern machine tools, systematic and able to get work out at the least cost; write, stating previous experience. wage and references. Address Box 876, AMERICAN MACHINIST.

Wanted—Superintendent for factory, including brass foundry, making highest grade plumbing fixtures; a record of ability and successful handling of men is necessary. Address, stating salary expected, the Meyer Sniffen Company, 5 East 19th st., New York.

First-class, all-around good machinists wanted; steady work for intelligent, capable and reliable men only, with a concern building machinery for its own use exclusively; references and qualifications required. A. Kimball Co., 307 West Broadway, New York.

OHIO.

Wanted—In Cleveland, O., man who has installed piece-work system in factory making small sheet-metal stampings of many different articles; state experience and salary desired. Box 850, AMERICAN MACHINIST.

Wanted—Mechanical designer and draftsman who is capable of superintending a small shop building butchers' and bakers' machinery; must speak German and English; a very good opportunity. Address "N. E. M.," care AMERICAN MACHINIST.

Wanted—First-class foundry foreman, with executive ability, to take charge of foundry employing 200 hands; medium and light, floor, bench and machine molding; good salary to competent man. Address, with reference, Box 872, AMERICAN MACHINIST.

PENNSYLVANIA.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMERICAN MACHINIST.

Draftsman—A large manufacturing concern in Western Pennsylvania wants first-class draftsmen with experience on steam engines. Box 885, AMERICAN MACHINIST.

Wanted—A good mechanical draftsman with ability to help design; state experience, references and salary wanted. Wilson Laundry Machinery Company, Columbia, Pa.

TENNESSEE.

Wanted—A draftsman who has had experience in coal mining, contracting machinery and structural iron work; steady position. Wm. J. Oliver Mfg. Co., Knoxville, Tenn.

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Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
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Binsse Mach. Co., Newark, N. J.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee, Wis.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.
Springfield Mch. Tool Co., Springfield, O.
Stow Mfg. Co., Binghamton, N. Y.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bullard Mach. Tool Co., Bridgeport, Conn.
Colburn Mch. Tool Co., Franklin, Pa.
Gisholt Mach. Co., Madison, Wis.
Harrington, Son & Co., Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
King Mach. Tool Co., Cincin., O.
McCabe, J. J., New York.
Niles-Bement-Pond Co., New York.
Poole Co., J. Morton, Wilmington, Del.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. & Tool Co., Ridgway, Pa.

Boring and Turning Mills *Continued*
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Bown Mach. Co., Battle Creek, Mich.

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Standard Welding Co., Cleve., O.

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Burr & Sons, John T., Brooklyn, N. Y.
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National Mach. Co., Tiffin, O.
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Williams, White & Co., Moline, Ill.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Walker Co., O. S., Worcester, Mass.

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Athol Mach. Co., Athol, Mass.
Mass. Tool Co., Greenfield, Mass.
Smith, Ernest G., Columbus, Pa.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
See Grinding Wheels.

Case-Hardening
Rogers & Hubbard Co., Middletown, Conn.

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Messmer Mfg. Co., Ferd., St Louis, Mo.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

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Cornell Co., J. B. & J. M., New York.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Fuchs & Lang Mfg. Co., New York.
Massey Mach. Co., Watertown, N. Y.
Poole Co., J. Morton, Wilmington, Del.
U. S. Foundry & Sales Co., South Norwalk, Conn.
Yale & Towne Mfg. Co., Stamford, Conn.

Castings, Motor
Harrison, H. K., St. Paul, Minn.
Steffey Mfg. Co., Philadelphia, Pa.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
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Clark Cast Steel Cement Co., Shelton, Conn.

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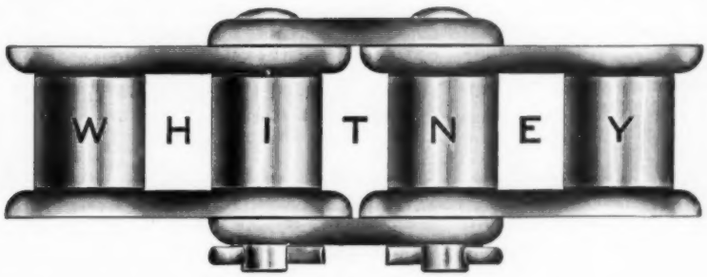
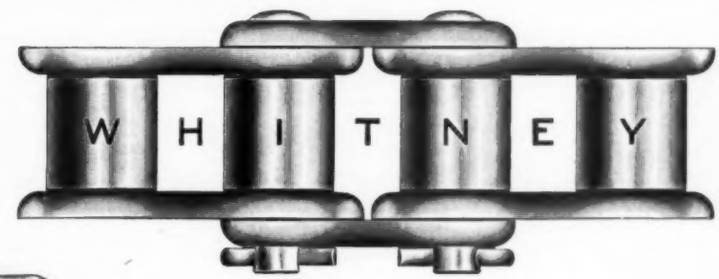
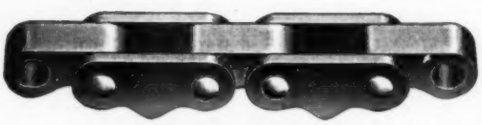
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

"WIZARD" Chains and Sprockets—Patented

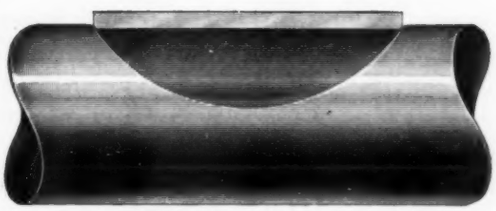


1906 Model "Whitney" Detachable Roller Chains—Patented

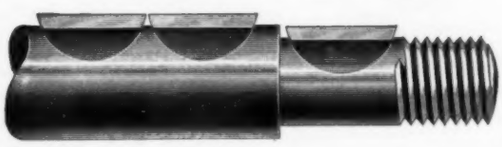




Block Chains



"Woodruff" Patent Keys



Three Popular Specialties

"Whitney" Chains
Hand (feed) Milling Machines
The Woodruff Patent System of Keying

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Woodward & Powell Planer Co., Worcester, Mass.

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Link Belt Engr. Co., Phila., Pa.
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Wiley & Russell Mfg. Co., Greenfield, Mass.

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Hoggson & Pettis Mfg. Co., New Haven, Conn.
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Westcott Chuck Co., Oneida, N. Y.
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Walker Co., O. S., Worcester, Mass.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Walker Co., O. S., Worcester, Mass.

Chucks, Split
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Cresson Co., Geo. V., Phila., Pa.
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Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
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Wood's Sons, T. B., Chambersburg, Pa.

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Compound, Boiler
Advance Mfg. Co., Kalamazoo, Mich.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

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Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Fulmer, Chas. F., Plainfield, N. J.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Mietz, August, New York.

Compressors, Gas
Ingersoll-Rand Co., New York.

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Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

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Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

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Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

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Cutler-Hammer Clutch Co., Milwaukee, Wis.
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Niles-Bement-Pond Co., New York.

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See Schools, Correspondence.

Cost Systems
Wright, Harold A., New York.

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Whitman & Barnes Mfg. Co., Chicago, Ill.

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Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Provi., R. I.

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Veeder Mfg. Co., Hartford, Conn.

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Builders' Iron Fdry., Prov., R. I.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

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Couplings, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
Byram & Co., Inc., Detroit, Mich.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Cranes, Portable
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Nicholls, Wm. S., New York.

Crank Pin Turning Machines
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts
Erie Forge Co, Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

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Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

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Erie Stamping & Mfg. Co., Erie, Pa.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Erie Stamping & Mfg. Co., Erie, Pa.
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International High Speed Steel Co., New York.
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Pratt & Whitney Co., Hartford, Conn.
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Pratt & Whitney Co., Hartford, Conn.
Western Tool Mfg. Co., Springfield, O.

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Veeder Mfg. Co., Hartford, Conn.

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Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
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American Tube & Stamping Co., Bridgeport, Conn.
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Kent & Co., Edwin R., Chicago, Ill.
Lutter & Gies, Milwaukee, Wis.
Niagara Mach. & Tool Wks., Buffalo, N. Y.
Swaine Co., Fred J., St. Louis, Mo.

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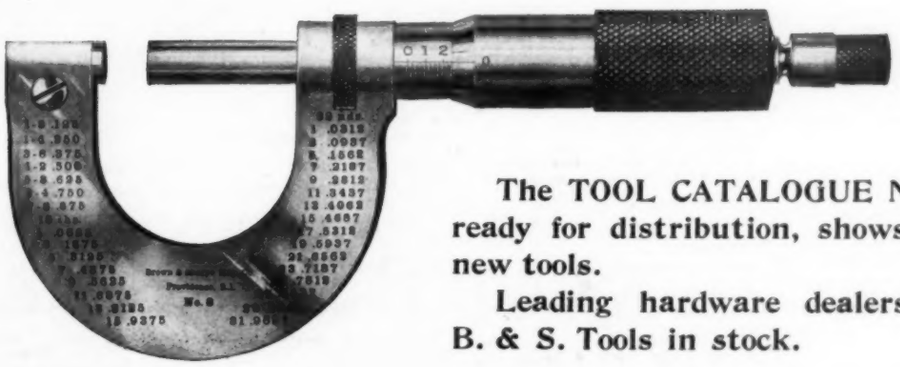

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Dreses Mach. Tool Co., Cin., O.
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Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.
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Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
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Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.

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Gould & Eberhardt, Newark, N. J.
Hamilton Mach. Tool Co., Hamilton, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
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Patterson Tool & Supply Co., Dayton, O.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

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Morse Twist Drill & Mach Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
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International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co. Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers, Boat, Gauge & Drill Wks., John M., Gloucester City, Mass.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.

Drills, Spindle
Three Rivers Tool Co., Three Rivers, Mich.

Drills, Twist
Montgomery & Co., New York.

Drills, Upright
Aurora Tool Works, Aurora, Ind.
Burke Mach. Co., Cleveland, O.
Davis Mach. Co., W. P., Rochester, N. Y.
Knecht Bros. Co., Cincinnati, O.

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Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Dynamotors
Sprague Elec. Co., New York.

Electrical Supplies
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Clark & Co., Jas., Jr., Louisville, Ky.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Roth Bros. & Co., Chicago, Ill.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Clark & Co., Jas. Jr., Louisville, Ky.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Roth Bros. & Co., Chicago, Ill.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Dickson, Thos. L., New York.
Francis & Co., Hartford, Conn.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical
Dodge & Day, Philadelphia, Pa.
McGlehan & Co., C. H., New York.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.
Reeves Pulley Co., Columbus, O.
Robertson Mfg. Co., Buffalo, N. Y.

Engines, Gas and Gasoline
Automatic Mach. Co., Bridgeport, Conn.
Blaisdell Machinery Co., Bradford, Pa.
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.

Engines, Gas and Gasoline
Continued
Matthews, Hugh, Kansas City, Mo.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Robertson Mfg. Co., Buffalo, N. Y.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., W. H., Wilkesbarre, Pa.

Extractors
Oil & Waste Saving Mach. Co., Philadelphia, Pa.

Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Nicholson File Co., Prov., R. I.
Reichheim & Co., E. P., New York.

Filing Machines
Cochrane-Bly Co., Rochester, N. Y.
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Fillets, Leather
Cleveland Fillet Co., Cleveland, O.

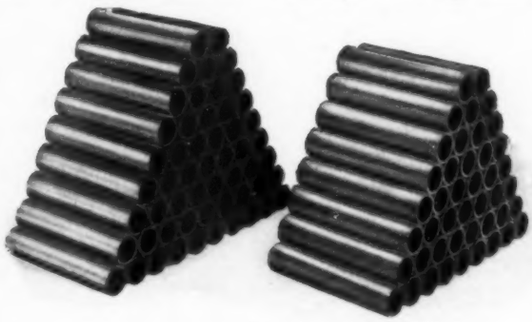
Fire Extinguishers
Badger & Sons Co., E. B., Boston, Mass.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.
Stow Mfg. Co., Binghamton, N. Y.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Burke Mach. Co., Cleveland, O.
Miner & Peck Mfg. Co., New Haven, Conn.
Ingersoll-Rand Co., New York.
National Mach. Co., Tiffin, O.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Some Samples of Work Done On a Landis Grinder

Landis Grinding Machines will produce more work, better work and more profit than can be produced by any other grinding tool or method.

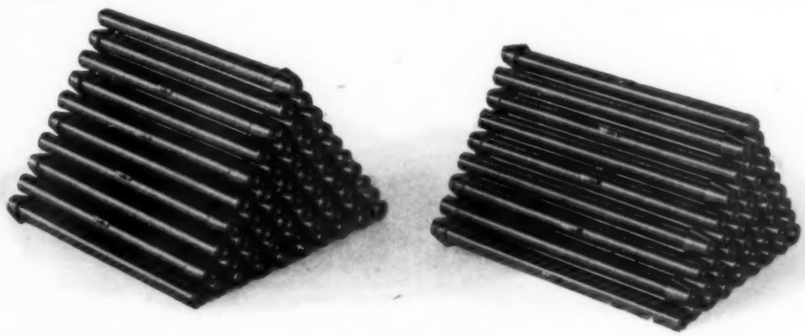


98 PIECES.

Cast Iron Drums, 3" diameter, 15" long. Ground from rough casting. ⅛" to $\frac{5}{16}$" removed Average time, 10 minutes.

10 PIECES.

Emery Wheel Spindles. 3¼", 3½", 3⅝", and 4½" diameter, 26½" long. .050" removed. Average time, 1 hour.

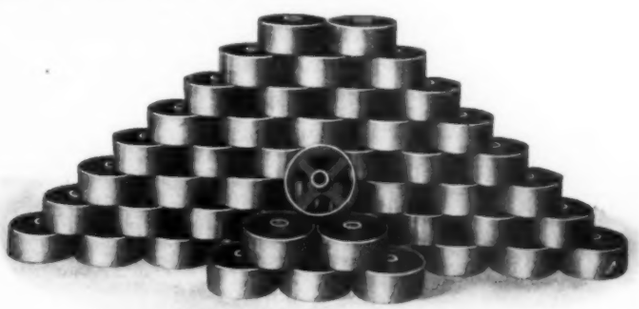


100 PIECES.

Pinion shafts, 1¼" diameter, 18½" long. Finished including taper, .060" removed. Average time, 18 minutes. Ground on No. 23 Plain Machine.

35 PIECES.

Hardened Spindles. 1⅞" and 2⅛" diameter, 8¾" long. .035" removed. Average time, 19 minutes.



50 PIECES.

Crowned pulleys, 8" diameter, 3¼" face. Ground from rough castings, ⅛" removed. Average time, 12 minutes.

Landis Tool Company, WAYNESBORO, PA. U.S.A.

AGENTS—Walter H. Foster Co., 513 Williamson Building, Cleveland, Ohio. Walter H. Foster Co., 114 Liberty Street, New York. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

Forgings, Drop
Anderson & Sons, W. H., Detroit, Mich.
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Anderson & Sons, W. H., Detroit, Mich.
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.
Kent & Co., Edwin R., Chicago, Ill.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Byram & Co., Inc., Detroit, Mich.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Friction and Countershafts
Wilmarth & Morman Co., Grand Rapids, Mich.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
Merritt & Co., Philadephia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Mass. Tool Co., Greenfield, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Foote Bros. Gear Mach. Co., Chicago, Ill.

Gear Cutting Machinery *Continued*
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Turley, Harvey G., St. Louis, Mo.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Foote Bros. Gear Mach. Co., Chicago, Ill.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Hardinge Bros., Chicago, Ill.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
Turley, Harvey G., St. Louis, Mo.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwad Co., I. & E., Cin., O.
Philadelphia Gear Wks., Philadelphia, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generating Sets
Burke Electric Co., Erie, Pa.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.,
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Boston, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Gem Mfg. Co., Pittsburg, Pa.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Rivett Lathe Mfg. Co., Boston, Mass.
Stow Mfg. Co., Binghamton, N. Y.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.

Grinders, Cylindrical
Brown & Sharpe Mfg. Co., Providence, R. I.
Heald Mach. Co., The, Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
Besly & Co., Chas. H., Chicago, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Diamond Mach. Co., Prov., R. I.
Gardner Machine Co., Beloit, Wis.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.

Grinders, Piston Ring
Heald Mach. Co., Worcester, Mass.

Grinders, Portable
Cincinnati Electrical Tool Co., Cincinnati, O.,
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Burke Mach. Co., Cleveland, O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Lutter & Gies, Milwaukee, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Walker Co., O. S., Worcester, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., W. F. & Jno., Rockford Ill.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Machine Co., Cin., O.
Independent Pneu. Tool Co., Chicago, Ill.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Montgomery & Co., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Patterson Tool & Supply Co., Dayton, O.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Robertson Mfg. Co., Buffalo, N. Y.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Stow Mfg. Co., Binghamton, N. Y.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Walker & Co., O. S., Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

The United States Arsenal at Frankford—I.

BY F. A. STANLEY.

Frankford Arsenal, best known perhaps as our national factory for small-arms ammunition, though it handles and manufactures considerable other material, is located in the city of Philadelphia, on a tract of land of some sixty acres, lying at the confluence of the Delaware river and Frankford creek, the site being about six miles northeast of the State House and the main gate of the arsenal within one-quarter of a mile of the Bridesburg station of the Pennsylvania Railroad. The ground here rises about 36 feet above sea level and lies from 10 to 12 feet above the tidewater of the Delaware.

FIG. 1. MAIN ENTRANCE TO FRANKFORD ARSENAL.

EARLY HISTORY OF THE ARSENAL.

The arsenal was established in 1816, the land purchased at that time consisting of a tract of 20¼ acres, for which $7,685.75 was paid. Additional purchases made at various times up to 1849 increased the area to 63 acres and the expenditure for the site to about $31,000. The locality at that time was known as the town of Whitehall, which was later merged into the borough of Frankford, the whole section being incorporated in the city of Philadelphia in 1850.

The arsenal's first commandant was Capt. Joseph H. Rees, and the first building to be erected was a storehouse, now long since destroyed. The work attended to for some years was largely in connection with repairs of infantry and artillery equipment, with now and then a few new parts constructed. Thus in 1826, according to the report of Lieut. T. I. Baird, the officer then in charge, there were 93 packing boxes made; 32 muskets cleaned and oiled; 350 swords cleaned and repaired; 100 gun slings and 8 rammers and sponges made.

Up to the time of the Mexican war the operations, in addition to those of the character just noted, included the manufacture of brushes and picks, bayonet slings, percussion primers, grape shot, 12-pounder strapped shot, etc., and the testing and proving of powder for musket and rifle. During this period various buildings were erected, and the arsenal became a large storage place for material manufactured in other establishments.

It was along in the early "fifties," before machinery began to be introduced to any extent at the arsenal. From that time on till the Rebellion, the variety of products increased, additional workshops being erected and equipped with the necessary apparatus, which in many instances was made on the premises. Among the appliances there constructed were some cap machines, machinery for drawing friction tubes, two screw presses for primer making, drill presses, and special machines for counterboring, tapping and rifling musket barrels.

The latter machines were made necessary because of the decision of the military authorities to have the flint-lock musket of the 1822 model and the smooth bores of 1842 changed to rifled muskets, and each year for several years preceding the War of the Rebellion thousands of the old-model arms were altered at Frankford, the flint-locks being replaced with self-priming locks and chambered breech-pieces, and the arms provided with sights and rifled. The rifling machines noted were fitted with double sets of cutters and cut three grooves in three barrels all at one time. Along with this work the arsenal was manufacturing annually hundreds of thousands of primers and percussion caps for small arms, friction tubes for cannon, musket balls, etc., and making also lanyards, cartridges, cartridge cases, bridles, and much other material required by the service. A good many gages for inspecting and testing small arms and cannon were also constructed at this period, and still another item coming under the operations at the arsenal was the inspection of thousands of barrels of gunpowder. The commanding officer at this time was Major Peter V. Hagner, who succeeded Major G. D. Ramsay—the commandant following the Mexican War period—in 1852.

THE ARSENAL DURING THE CIVIL WAR.

In 1855 the muzzle-loading percussion arm generally known as the Springfield rifled musket, model of 1855, was adopted

FIG. 2. MAIN ENTRANCE AND GUARD HOUSE.

for the infantry branch of the service, and its manufacture in large numbers was immediately commenced at the Springfield Armory and also at the armory at Harper's Ferry, which up to the time of its destruction, in the early part of the war,

FIG. 3. THE MACHINE SHOP.

was an important national factory for the construction of small arms. This rifled musket used an elongated expanding ball cartridge of caliber .58, and, with the .69 caliber musket of 1842, was issued in great numbers to the infantry at the breaking out of the Rebellion in 1861. It is interesting to note here that these earlier rifled muskets, instead of having the rapid twist given modern arms, were provided with rifling grooves making but one turn in 6 feet.

The work of manufacturing ammunition for these arms was, of course, an important one at Frankford, although forming but one of many operations carried on there during the Rebellion. At the outbreak of the war the plant and working force were considerably increased, and a great variety of products were turned out, these including besides the paper and linen cartridges of the calibers noted above, musket balls, pistol ball cartridges, elongated balls for Maynard carbines, Sharpe's carbine cartridges .54 caliber, and other cartridges for various arms of private manufacture, which were largely used by the cavalry during the war. Further products of this period were flannel cartridge bags, watering bridles and saddle bags, canister and case for 3-inch rifled guns, 20-pounder shells, front sights for field guns, etc. During this time the arsenal received, stored, inspected and forwarded supplies contracted for, such as horse equipments, gun and howitzer caissons, howitzers, shot and shell, swords, musket and mortar powder, and an endless variety of material necessary to the prosecution of the war.

At one period of the war (1864) there were nearly 1,300 employees at Frankford, these working in night and day shifts, and the plant had a capacity of 1,000,000 rounds of small-arms ammunition and 50,000 primers per day. An idea of the amount of such ammunition used in the war by the Union troops may be gained from the figures of the Chief of Ordnance, who in 1867 reported to the Secretary of War that from January 1, 1861, to June 30, 1866, the government manufactured over 646,000,000 cartridges for muskets, nearly 51,000,000 for carbines, and 64,000,000 for pistols. In addition there were purchased from private manufacturers in the neighborhood of 240,000,000 cartridges of various kinds.

The period 1861 to 1865 saw several different officers in charge of the establishment. Just prior to the firing on Fort Sumter Capt. Josiah Gorgas was in command. He resigned, however, in April, 1861, to enlist in the cause of the Confederacy, and for a year following Lieut. T. J. Treadwell was in charge. He was relieved in 1862 by Major Theo. T. S. Laidley, who commanded until the latter part of 1864, after which and until the fall of the year 1869 Lieut.-Col. S. V. Benet was the commandant.

OPERATIONS FOLLOWING THE WAR.

Upon the cessation of hostilities in April, 1865, the work at the government arsenals and armories was greatly reduced, and the operations at Frankford for at least a year and a half were confined principally to the fabrication of a limited number of experimental metallic cartridges for Gatling guns of 1-inch caliber, and the manufacture of Morse, Burnside, and a few other small-arms cartridges. During the war a good many breech-loading rifles of various makes had been used in certain branches of the service, and most of the metallic ammunition for these was rim primed.

In 1866 the War Department decided to adopt a breech-loading arm in place of the old muzzle loader with which most of the troops in the Civil War had been supplied, and after an examination of various types approved a plan submitted by Master Armorer Allin, of Springfield armory, and gave orders for the conversion at that establishment of 25,000 muzzle loaders into breech-loading rifles of .50 caliber. Orders were given at the same time for the manufacture at Frankford of center-fire metallic cartridges for these rifles, and special machinery for the purpose was devised and installed as soon as practicable.

This cartridge, though a center primed affair, had a copper case, and its manufacture was carried on very successfully, though it was, to a large extent, new work to all concerned; the plant in 1868 had a capacity of 50,000 such cartridges per day. Successive improvements were made in the firearm at Springfield up to the early '70s, and in 1873, after examination and extensive tests of over 100 different arms by a board appointed for the purpose, the "45 Springfield" was adopted. The manufacture of ammunition for the latter was commenced at Frankford in 1874, and continued until after the Spanish war; for, although the regulars were then armed with the Krag Jorgensen caliber 30 magazine rifle, the volunteer troops went to the war carrying the old Springfield single loader, which had, of course, been greatly improved since it was first adopted.

In addition to rifle cartridges, during this period the arsenal was turning out among other munitions cannon percussion primers, electric primers, fuses, pressure disks, cartridge bags, targets and pasters, gun sights, quadrants, shells for breech-loading rifles, shrapnel, testing gages, .38-caliber revolver ammunition. Then in 1892, after thorough examination and test of fifty-three types of rifles of home and foreign origin, the War Department adopted the Krag Jorgensen, and the making of ammunition for this arm was turned over to Frankford Arsenal, then under the command of Lieut.-Col. J. P. Farley. Starting in with a small plant for the work, it was gradually expanded until by 1898 the output of .30-

FIG. 4. GENERAL VIEW OF ARSENAL SHOPS FROM THE NORTH.

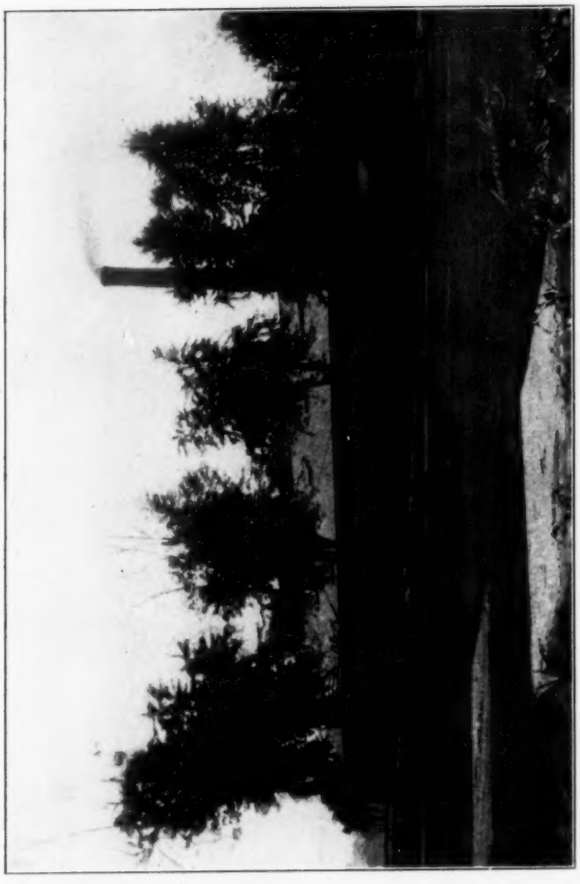


FIG. 6. THE CARPENTER SHOP.

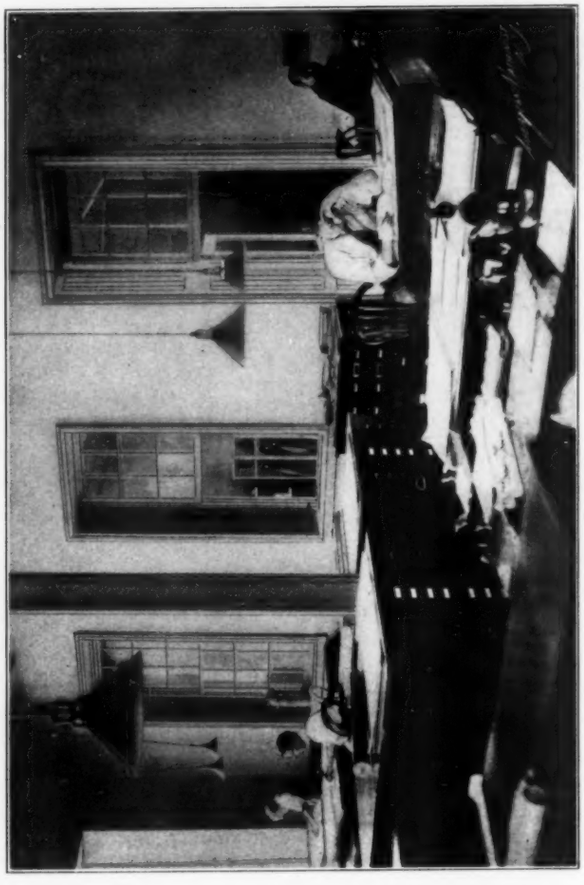


FIG. 8. THE DRAWING OFFICE.

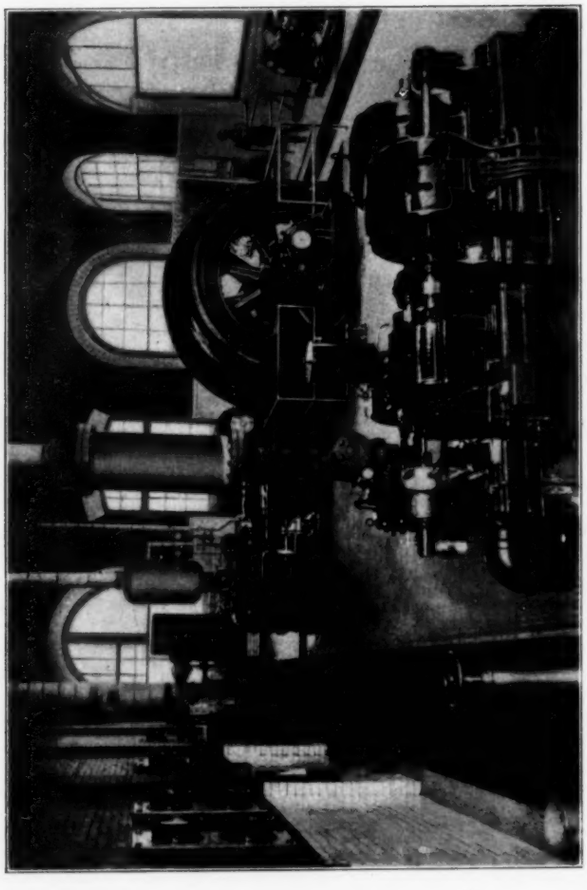


FIG. 5. VIEW IN POWER PLANT.

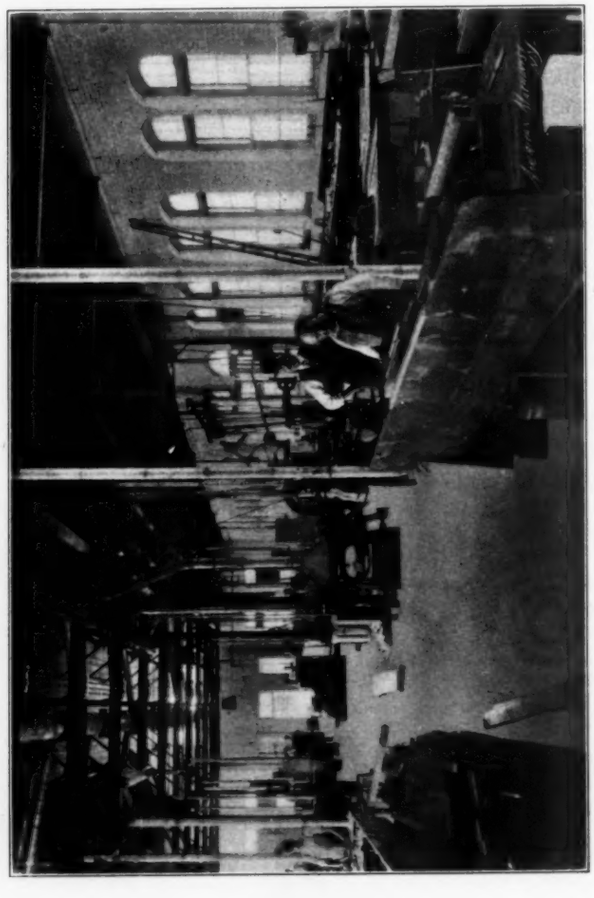


FIG. 7. INTERIOR OF CARPENTER SHOP.

caliber cartridges, loaded with smokeless powder—which was then just coming into use in our service—was 180,000 per day.

THE ARSENAL DURING AND SINCE THE SPANISH WAR.

Col. J. M. Whittemore was in charge of the arsenal from 1897 to 1900, and his reports to the Chief of Ordnance indicate that it was an exceedingly busy establishment during the war with Spain. In 1898 over 37,000,000 cartridges, 17,000 shrapnel and 100,000 fuses were manufactured; also a considerable variety of material, of which gunners' quadrants, inspecting instruments, and sights for 3.2- and 5-inch B. L. rifles made up a part. Owing to the magnitude of operations at this time, only shrapnel ammunition for the field and siege artillery was made at Frankford, the manufacture of shell ammunition being transferred to Watervliet Arsenal. While additional machinery for shrapnel, fuses and small-arms ammunition was hastily installed, it was of course impossible to meet at once the requirements of the war, so large quantities of such material were contracted for with outside parties; and inspectors from Frankford Arsenal supervised in 1898 the manufacture at private establishments of no less than 39,000,000 cartridges.

Since that time a new cartridge factory has been installed; and during the administration of the present Commandant, Lieut. Col. Frank Heath, who, as a Major of Ordnance, was placed in charge March 27, 1900, the cartridge plant has been enlarged, and new shops have been erected and equipped for artillery-cartridge, fuse and shrapnel manufacture. Also a new power-house, carpenter shop, packing shop, storehouse and other buildings have been added to the plant.

The variety and quantity of stores kept at the arsenal have been greatly reduced in recent years, and much of the miscellaneous manufacture carried on there during earlier periods has been discontinued entirely or transferred to other arsenals. The principal operations to-day are in connection with the manufacture of cartridges for the caliber .30 rifle, model 1903, and for other small arms, also ammunition for field and siege artillery and for sea-coast artillery up to 6-inch; the construction of instruments for controlling and directing the fire of seacoast artillery; the making of field-gun sights, quadrants, inspecting instruments, gages and other tools; the testing of ammunition, etc. The work is all of a very interesting nature, and several of the different branches will be illustrated in this series of articles.

To supervise the various operations, there are to-day at Frankford, under the commanding officer, a lieutenant-colonel, two captains and two lieutenants of the Ordnance Department, and to guard the grounds and buildings there is a garrison of about fifty soldiers. The civilian force employed in the different departments numbers about 1,200 hands.

THE GROUNDS AND MAIN BUILDINGS.

The main entrance to the arsenal is illustrated in Figs. 1 and 2, and these views give an idea of the neatness with which the grounds are kept up. Fig. 3 is a view of the machine shop, which is the oldest of the main manufacturing buildings. In this shop practically all of the manufacturing operations were concentrated during the Civil War; and in fact, the cartridge work was not removed to other buildings until a very few years ago. The headquarters or administration building is almost midway between the main gate and machine shop, and is also one of the older of the arsenal structures. It is two stories high, of brick, and divided longitudinally into two rows of offices on each floor.

A general view of the present main manufacturing buildings is presented in Fig. 4, which shows the shops along the sides of a large grass plot. From left to right, the first structure is the large cartridge case plant; the second, the cartridge factory; the third, the packing and boxing shop for cartridges; the fourth, the storehouse. The present cartridge shop was erected during the Rebellion, the intention being to use it as a rolling mill. It was never utilized for the purpose, however, and a few years ago, just after the Spanish War, the cartridge machinery was removed thereto from the machine shop, and much new machinery added, the whole building now being occupied with the production of small-arms ammunition. The other buildings in the group are newly erected structures as previously mentioned, and all are of brick and steel, and two stories high, with attic and basement. It should be stated here that Frankford creek flows just to the rear of the line of shops, and a spur track from the Pennsylvania system leads directly into the yards, so that material may be readily received and shipped either by water or rail.

THE POWER PLANT.

An interior view of the power plant, which is located at the rear of the artillery cartridge shop, is given in Fig. 5. The power house was completed about two years ago, and supplies current for lighting the buildings and grounds and for operating all departments which are motor driven. The equipment includes a Rice & Sargent 350 horse-power engine, direct-connected to a General Electric 250-kilowatt generator, producing alternating current at 220 volts; a De Laval turbine alternator of 75 kilowatts, and exciters, air compressor, etc. Steam is supplied from five Babcock & Wilcox boilers of 200 horse-power each, the furnaces for two of these being fed by Roney stokers. The basement of the power house has lockers and shower baths for the station attendants; and subways leading off from beneath the switchboards permit the cables to be carried underground to the different buildings.

THE CARPENTER SHOP AND MACHINE SHOP.

The carpenter shop, illustrated in Figs. 6 and 7, is a long, one-story affair of recent construction, and well equipped with modern wood-working machinery, all of which is electrically driven, each machine having its individual motor. This department attends to the making of boxes, shipping cases, patterns, etc., and employs about two-score workmen.

The drafting room is on the second floor of the machine shop, and is represented in Fig. 8. Figs. 9 to 12, inclusive, are of different manufacturing departments in the machine shop. The first of these shows the main floor; the second the sight-manufacturing job on the second floor, where front and rear sights and range quadrants, etc., for field guns are made; the third the instrument department on the same floor, where telescopic sights and similar instruments are kept in order; the last, Fig. 12, a corner of the plotting-board department below. The various departments in the building give employment to over 200 men.

The Whistler plotting board, of which several hundred have been, or are being, made at Frankford, is an ingenious device used in sea-coast fortifications for directing the fire of the guns, and consists essentially of a semi-circular board having a radius of about four feet, with a graduated brass ring (known as the azimuth circle) at the periphery and two swinging, graduated arms whose pivotal points, located along the base line, or diameter of the semi-circle, correspond in position to the relative positions of two observers in the fort. The base line is graduated to a scale of several hundred yards to the inch, with a vernier for giving single yard readings, and the azimuth circle is graduated in degrees and tenths. When a ship to be fired upon is sighted the observers at the two fixed points communicate the angles to the operator at the board, who sets the swinging arms to correspond, and thus secures readings at their intersecting points, from which the leading guns of the battery may be accurately trained upon the vessel.

The brass half-circle (azimuth circle) is end milled along its entire face to receive a sliding head carrying the outer end of the main arm of the plotting board, and dovetailed to receive a graduated strip; the edge of the ring is provided with vertical notches for quick setting of the arm to even degrees. It is in milling the faces and dovetail and notching the edge of this ring that the special machine in Fig. 12 is utilized. The half ring is built up double, of segments 46 inches long, overlapped and riveted together, and is dropped into brass plugs secured in the face of the miller table and lightly

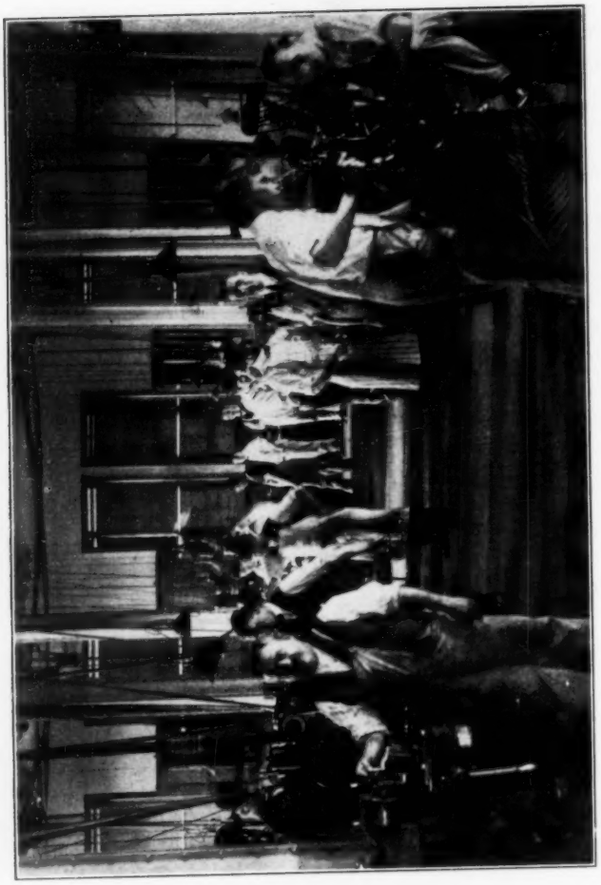


FIG. 10. SIGHT DEPARTMENT IN MACHINE SHOP.

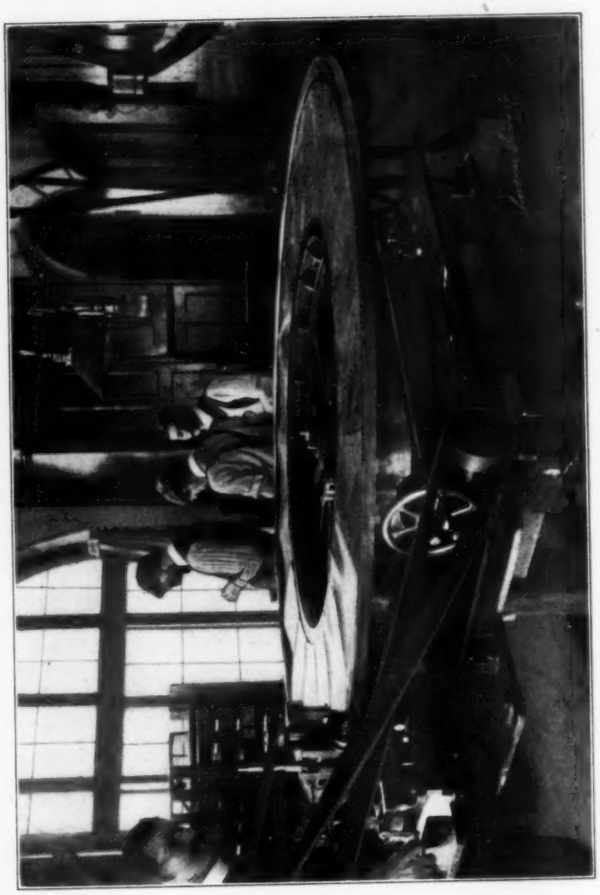


FIG. 12. A SPECIAL INDEXING AND MILLING MACHINE.

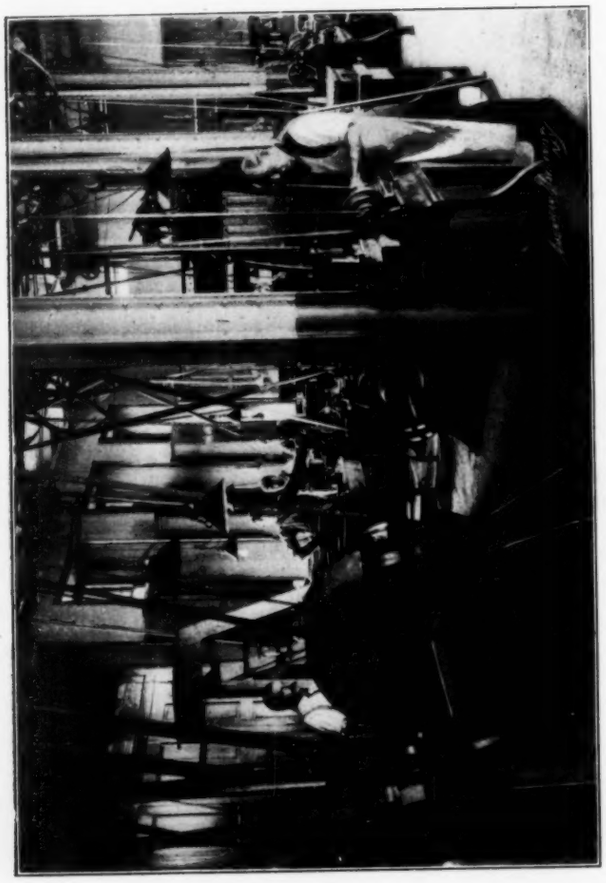


FIG. 9. MACHINE SHOP—FIRST FLOOR.

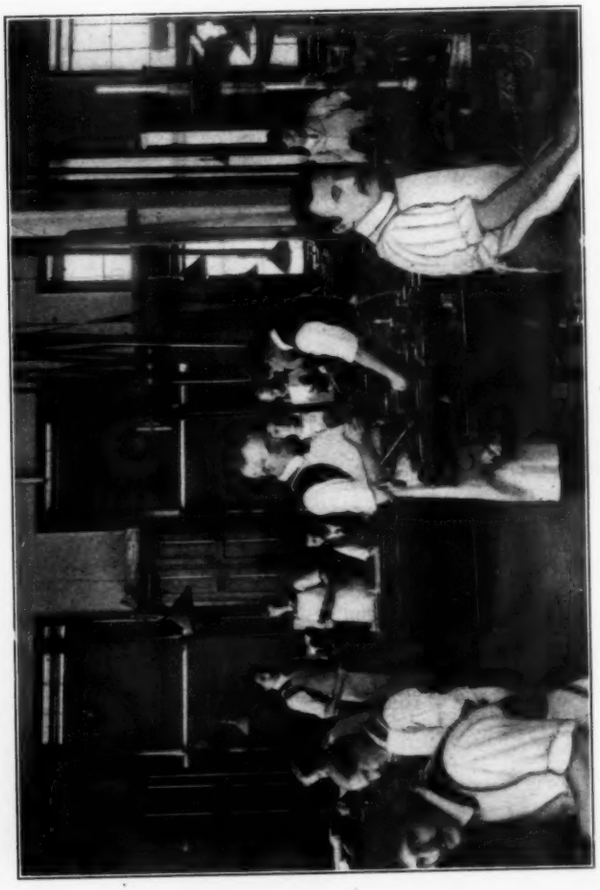


FIG. 11. INSTRUMENT DEPARTMENT IN MACHINE SHOP.

clamped for machining. A pair of end mills in vertical spindles finish the different surfaces, the rotary movement of the table being obtained as indicated, by means of worm gearing. For cutting the indexing notches in the periphery a special head carrying the milling cutter is substituted for the vertical-spindle attachment, and the table is then indexed by hand by means of the wheel on the worm shaft and the center passed by a hand-lever across the work-face. The method of resting the ring on plugs prevents its springing, and the whole device is well worked out for handling with facility a delicate and accurate piece of work.

Alcohol for Automobiles.

The use of alcohol for automobiles was discussed at a meeting of the Automobile Club of America, the evening of November 28. Whidden Graham addressed the club on the subject, and among other things said: "You may be interested in knowing that the farmers throughout the country are deeply interested in the efforts now being made to introduce a bill in the next Congress asking that the tax on industrial alcohol be taken off. There would be no loss of revenue to the Government, for the tax would still remain on the highest-grade alcohol used for beverage purposes, and the manufacture of colognes. In America last year about 5,000,000 gallons of alcohol were used, whereas in Germany 73,000,000 gallons were used. Alcohol at a 90 per cent. grade ought to be manufactured to sell at a fair profit from 18 to 20 cents a gallon. This can be denaturized so as to be unfit for beverage uses. Alcohol motors are now being used to a wider extent than is generally known, and the lighting plant of Matanzas, Cuba, is run entirely by alcohol motors.

"Some of the advantages in the use of alcohol for motor purposes are its cleanliness, its safety, and its freedom from disagreeable odors. For commercial vehicles I believe it will be extensively used in the future. There is no limit to the supply of alcohol. On the other hand the supply of gasolene is limited, and the problem of the future gasolene supply at the present rate of consumption is a serious one."

Prominent members of the club discussed the matter and it was brought out that the average supply of gasolene in this country is about 40,000,000 gallons, of which half is exported.

It is stated that the Pennsylvania Railroad is planning to place its telegraph lines in underground conduits, starting by one from Philadelphia to Lancaster, the lines to New York and to Washington being the next to be considered. This progressive step, which will do away with the annual interference by wind and snow, is very commendable.

The Double Cam System of the Monotype.

EDITORIAL CORRESPONDENCE.

As originally made the cams of the Monotype were of the face variety, with a raceway for the roller; that is, both acting and return movements were positive. In use these cams proved to be short lived, both roller and raceway wearing badly, so badly in fact, that with some of the cams the usual life did not exceed six months, and this with hardened rollers and pins and with steel pieces inserted in the cams at the places where the greatest wear developed. On investigation the conclusion was reached that this was due to the resistance offered by the inertia of the roller to reversal on its pin, for, with this style of cam, such reversal accompanies each change of the roller from the inner to the outer surface of the groove and *vice versa*. While this action is always present with this style of cam, it was accentuated into a serious matter in this case by the unusual speed of the cam shaft—140 revolutions per minute—and the resulting inertia developed in the rollers.

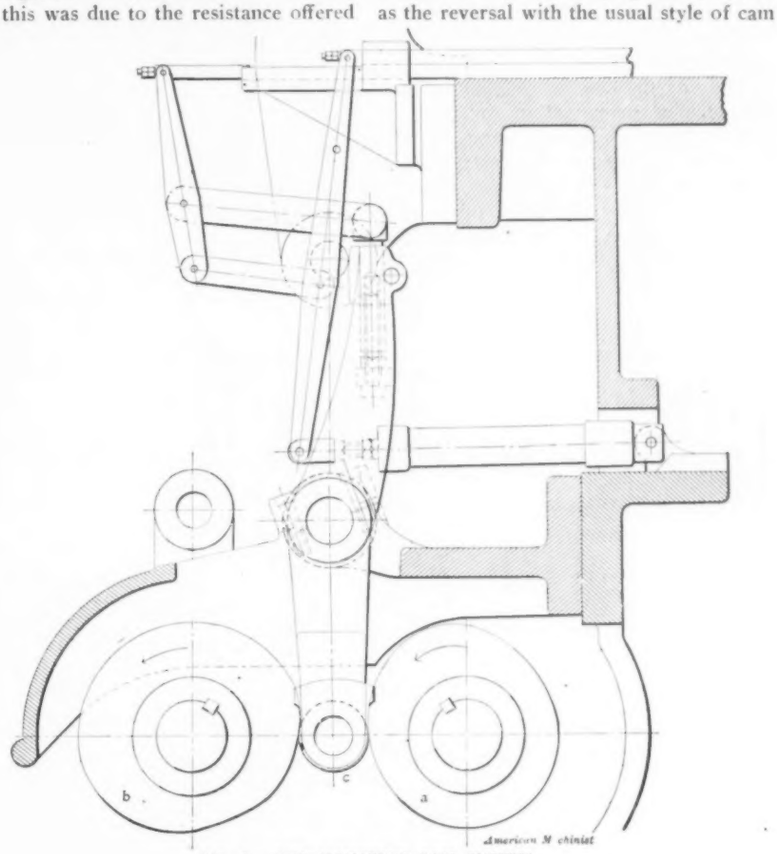


FIG. 1. THE MONOTYPE CAM SYSTEM.

In order to overcome the difficulty the cam system shown in Fig. 1 was devised, in which a pair of conjugate cams, *a* and *b*, are keyed to a pair of shafts which are so geared as to run at the same speed and in the same direction as indicated by the arrows. The roller *c* lies between them and is driven in one direction by one cam and in the opposite by the other—the two cams being formed by methods to be described, which insure the absence of slack between them and the roller in all positions. It will be observed that with this arrangement the direction of rotation of the roller on its pin is never changed. Its speed, of course, varies with the diameter of the cam surface acting at the moment, and to this extent its inertia comes into play to induce sliding, but such changes in speed are small in comparison with reversal and, moreover, they are always gradual, whereas the reversal with the usual style of cam is abrupt. So successful has this construction proven that the life of these cams is unknown. They have now been in use for six years and in no case have they shown serious wear except when subject to obvious neglect in oiling. In other words, they are at least twelve times as durable, under the conditions of the Monotype, as the old style, and this with the cams made of gray iron.

MODIFICATIONS OF CAM CURVES FOR HIGH SPEED.

The inertia developed at the speed at which these cams run has given rise to other difficulties. At the start they were laid out from the crank-motion curve described by Mr. Smith in his articles which were published last spring, but modifica-

tions of this have been found necessary. At slow speed the acting cam will do as it is intended—push the roller the required distance—but at high speed the inertia of the driven parts comes into play in precisely the same manner as with the reciprocating parts of a high-speed steam engine. The parts are started from rest and their motion is accelerated to a maximum when they are slowed down to a stop. If the speed is high the inertia of the parts resists this stopping, precisely as the inertia of the reciprocating parts of an engine resists stopping. If this inertia exceeds the resistance which is offered to the movement of the parts, the roller leaves the acting cam and contacts with the return cam, which then stops it, precisely as the crank-pin of a high-speed engine stops the piston. The effect of this was to add the looseness of the joints to the intended movement of the parts or, with resistance before the parts, to make the movement uncertain in extent at the very point where certainty was essential.

The first remedy tried for this was to place springs before the parts to resist their movement, the idea being that the springs should be strong enough to more than overcome the inertia of the parts and thus cause the roller to keep contact with the acting cam throughout the acting movement, but it was found to be impracticable to use springs strong enough to accomplish this with the crank motion curve, and the final resort was to a modification of that curve.

The difficulty arises solely in the stopping of the parts and, the time during which the cam may effect the movement being fixed, the remedy is primarily to reduce the time during which the parts are accelerated and to increase the time during which they are retarded. This is shown in Fig. 2, in which the chart curve for one of the cams is given. The parts reach their maximum speed while the cam turns from *a* to *b*, which points include but 25 degrees of motion. From *b* to *c* the chart curve is straight, while the stopping occupies the angle from *c* to *d*, or 50 degrees. The curves as laid out are not based upon any formal system, but are simple arcs of circles. The starting curve is struck from the center *e*, while the retarding curve is composed of two arcs struck from *f* and *g*, which latter, by accident, falls upon the circumference of the extreme cam pitch circle. By the use of two arcs in the retarding portion of the curve, the negative acceleration of the driven parts is reduced at their point of union *h*, its value at the end of the movement, which is the chief point in consideration, being thus materially less than were the entire arc *c d* struck from a single center.

The location of point *h* is calculated with reference to the weight and velocity of the driven parts, and is so located that the energy of these parts, due to their velocity at point *h*, is small enough to be within the capacity of a practicable spring to absorb. By these means the difficulty has been entirely overcome. The return curve *i j* is formed in the same manner, the starting portion being struck from one center and the stopping portion from two, as shown. There is, however, no calculation of energy made for this curve, as it is unnecessary.

It will be observed that the steepest portions of the curve materially exceed the limiting angle of 30 degrees given by Mr.

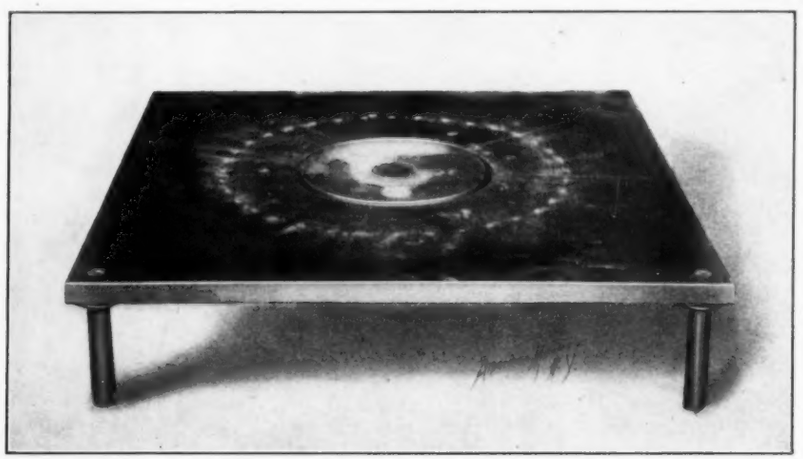


FIG. 3. IRON DRAWING BOARD FOR LAYING OUT MASTER FORMERS.

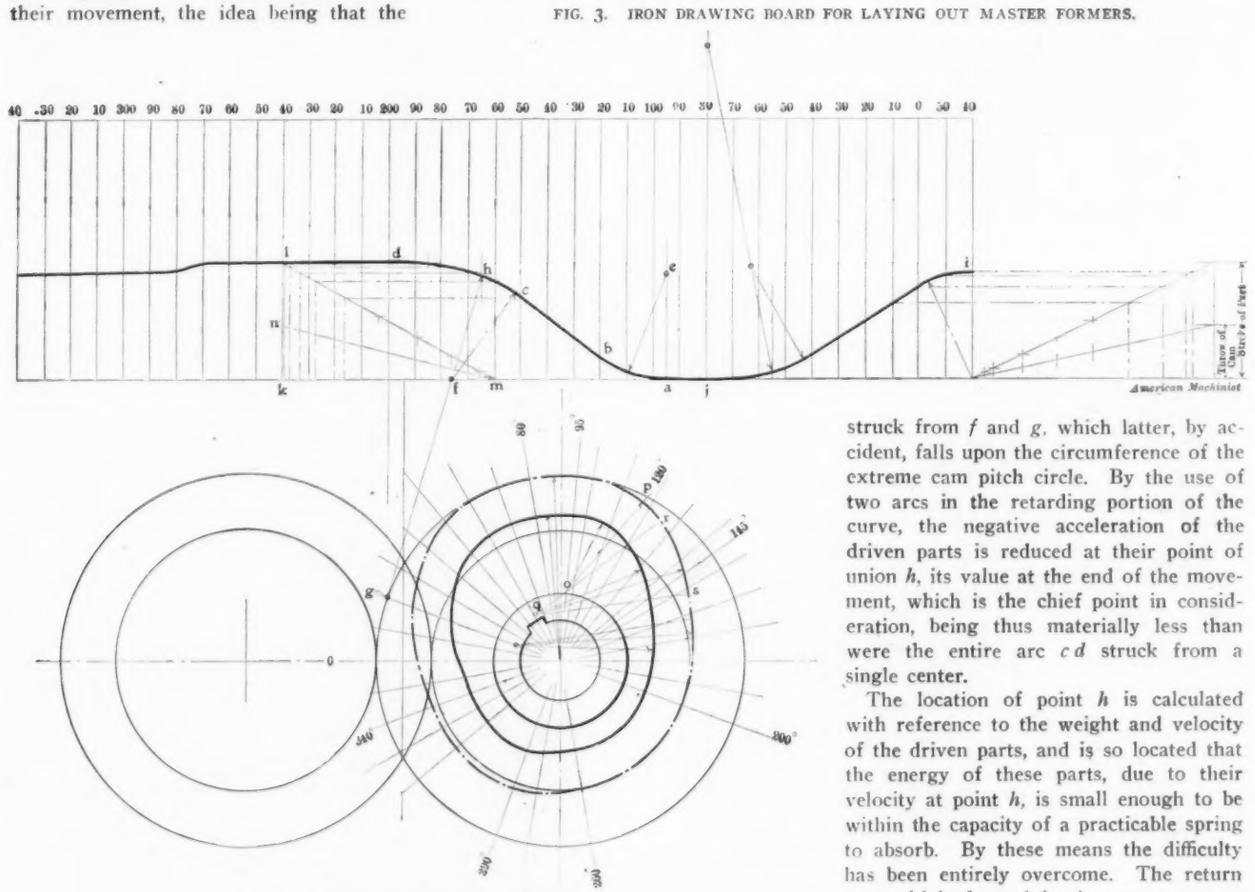


FIG. 2. LAYING OUT THE CAM CURVES.

Smith. The angle of *b c* with the base line measures with the protractor about 37 degrees.

It should not be understood that all the cams are laid out in this way. In some the weight of the parts or the required exactness of the movement is not such as to require it.

LAYING OUT THE CAM CURVES FROM THE CHART.

In the Monotype levers having equal arms are seldom used, and Fig. 2 shows the method of making the reduction. The chart curve is laid out to give the movement of the driven piece. If the cam is to have half the throw of this piece, for example, the height *k l* is divided in half and the lines *l m* and *n m* are drawn. Points on the chart curve being then projected to the line *l m* and from the intersection down to *n m*, the heights of the last intersections above the base line give the distances to be used in laying out the pitch curve of the cam. Circles representing the extreme diameters of the acting cam are then calculated and drawn, the calculation being based on the distance between the cam shafts, the diameter of the roller and the required movement. The various angular lines are then drawn and the height of the points on line *n m* are stepped off inside the outer circle. These points determined, their positions are approximated as closely as possible by a series of circular arcs. Thus the extreme diameter ends on the 95-degree line, as shown by the chart. The radius *o p* struck from a point on the radius line for this angle, gives the next portion of the cam pitch curve which extends to the line *q r*. From a point *q* on this line, the next portion of the pitch curve is drawn extending to the line *q s*, and so on. The actual cam curve is, of course, drawn from the same centers, the radii being reduced by the radius of the roller.

The mating cam is laid out in the same manner, although this is not shown in the drawing. The curve for the mating cam is, however, used only for the purpose of getting out the pattern and to insure that the curve does not contain structurally impossible forms, such as concave arcs of less radius than the cam roller. Should such curves develop, the chart must be modified to remove them. The actual transfer of the curve to the iron former is made for the acting cam of each pair only, the curve of the return cam being developed from it, as will be described.

OUTLINING THE MASTER FORMER.

The transfer of the curve to the master former is made by the use of the iron drawing-board shown in Fig. 3. This board contains a pocket in which the master former blank is dropped. A stump, fitted with a key on which the blank is a close fit, locates it positively in position, and a protractor ruled on the surface of the board, but only imperfectly shown in the half-tone, enables the angular lines to be ruled on the surface of the blank, which is coppered for pur-

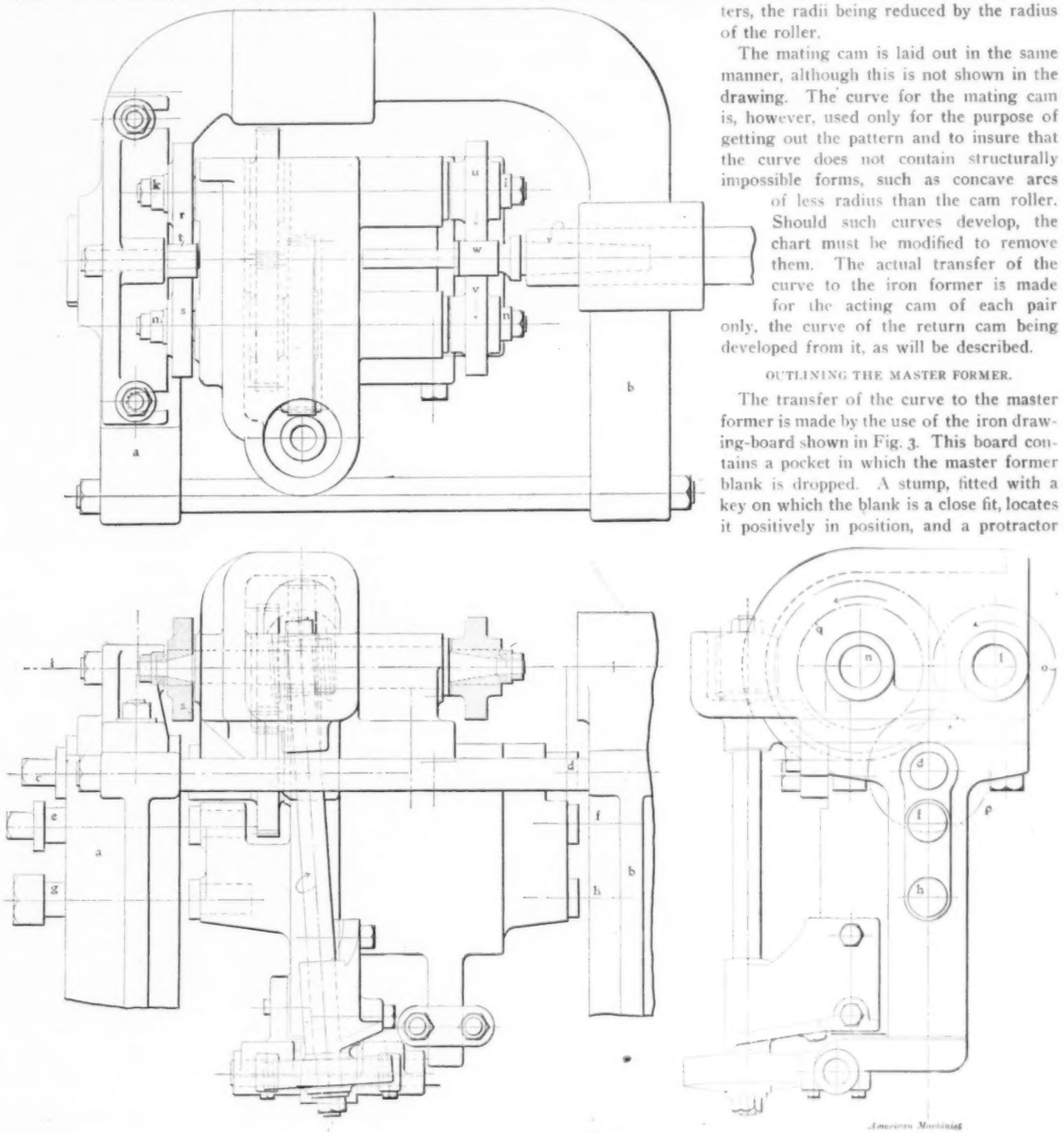


FIG. 4. DOUBLE-CAM CUTTING MACHINE.

poses of laying out. The profile of the drawing is then repeated with all possible care on the blank, the coppered surface permitting a good degree of accuracy, although in its main dimensions—the least and greatest radii which determine the movement—the accuracy is not dependent on this lay-out. The profile determined, the former is then dressed down to it by hand, the greatest and least radii being made to micrometer measurement, since the form of the cam obviously permits the application of the micrometer, the anvil being placed in the hole and the screw being applied to the outer surface. Should the cam make two or more steps in its movement, these steps are invariably accompanied by dwells which involve circular arcs in the cam profile and hence all the steps may be determined with micrometer accuracy.

THE CAM-CUTTING MACHINE.

The master former completed, the working formers are made in a cam-cutting machine, made by William Sellers & Co., of which the essential parts are shown in Fig. 4. This machine is regularly used for cutting the cams as manufactured for the Monotype, for which purpose two conjugate formers are used; but it also produces these working formers from a single master former, its working being such as to insure that these working formers are true conjugates.

The main frame of the machine is only indicated at *a b*. Within this frame a rigid box swings on trunnions *c d*, *e f* or *g h*, the distance of these trunnions from the cutter spindle center line *i j* being equal to the lengths of the cam ends of the cam levers and since, among the levers three such lengths are made, three sets of fulcrums are provided. In the illustration the upper set is in use, the others being withdrawn. The box carries two cam-shafts *k l* and *m n*, which are slowly revolved by worm gearing indicated by dotted lines, the final connection with the main driving gears being by a flexible shaft to permit the swinging of the box on its fulcrums. The two cam-shafts are made to revolve in the same direction and at the same speed by gears *o p q*, and the working formers, which we will suppose have been made, are mounted at *r s*, with a roller pin *t* attached to the frame between them. The cam blanks are at *u v*, and the milling cutter at *w*. As the formers revolve they obviously cause the box, their shafts, themselves and the blanks to swing on the fulcrums while the blanks are cut by the cutter, which is of the same diameter as roller *t*, to the same form as the formers. The making of the working formers from the master formers is done in precisely the same manner, except that, there being but one master former, the swinging box is weighted during this operation to cause the master former to maintain contact with the roller pin *t*. A single master former is thus made to produce a pair of working formers, which, from the manner of their formation must be true conjugates, and, when placed on the former ends of the shaft, must work properly with the roller and without introducing slack in the movement of the swinging box, and thus reproduce their forms indefinitely.

The system of cams described, together with the machine for making them, originated with J. Sellers Bancroft, for many years superintendent of Wm. Sellers & Co.'s works, and now general manager of the Lanston Monotype Machine Company.

F. A. H.

A Large Steel-Concrete Stack.

The following are particulars of what is believed to be the largest and highest concrete chimney in the world, recently completed at the Butte (Mont.) Reduction Works:

The inside diameter (both top and bottom) is 18 feet, and the height of the chimney is 333 feet 4 inches, or 352 feet 7 inches above the surface; the top of the chimney has also the rather uncommon altitude of 5,791.3 feet above the sea level. The foundation of the chimney goes 7 feet below the surface, the lower portion being formed of slag poured in the molten state into a gray-iron casing 100 feet square, giving an area of 10,000 square feet. This process was repeated six times, giving a foundation 18 feet deep, tapering to 66 2-3 feet square at the top, and full of various forms of metal sown through the slag. As 7 feet of this are in the ground, there is necessarily a height of 11 feet above the ground. The base, which rests upon the slag foundation, is of Portland cement concrete, 42½ feet square and 8¼ feet high in the center, the concrete also having metal distributed through it, some of which projects up above the base, to help retain the walls of the chimney, having a resemblance to the roots of a tree. The chimney proper was formed in a system of sectional molds 3½ feet high, which, when coupled together, formed a complete ring. The concrete walls contain vertical and horizontal steel bars, the number reducing as the height increases, and also rings of 1-inch T-iron wired to the bars. For the first 21 feet in height of the chimney the walls are 18 inches thick, and in these walls are the two inlets to the chimney, one on each side, each opening 8x17 feet. On top of the 18-inch wall starts the double shell of the chimney, the outer shell being 9 inches thick, the inner shell 5 inches thick, these shells being separated by a 4-inch air space, which, at the bottom, is connected to the atmosphere through the outer shell by port-holes. The inside shell extends up to a height of 101½ feet above the base, and the outer shell is offset over the inner shell, as can be seen on the exterior of the chimney, the air space being left entirely open on the inner side of the chimney, and the inner shell perfectly free from the outer shell at the top. The outer shell is then carried 7 inches thick to the top of the chimney. The outside diameter of the chimney at the bottom is 21 feet, and the diameter of upper shell is 19 feet 2 inches.

The weight of chimney is as follows: Slag foundation, 12,800 tons; concrete base, 1,000 tons; chimney proper, 1,475 tons. This chimney, besides being the largest and highest concrete chimney in the world, is one of the largest chimneys of its height in the United States, as can be seen by comparing its dimensions with those of the following examples of some large chimneys in this country: The Washoe Copper Company's, at Anaconda, which is the largest in the world, is constructed of brick, and is 30 feet inside diameter and 300 feet high; the Metropolitan Street Railway Company's, New York city, of brick, 22 feet inside diameter, 353 feet high; the Clark Thread Works, Kearney, N. J., of brick, 11 feet inside diameter, 335 feet high; Omaha and Grant smelter, Denver, Colo., of brick, 16 feet inside diameter, 350 feet high; Orford Copper Company's, Constable Hook, N. J., radial brick, 20 feet inside diameter at the base, 13 feet at the top, 360 feet high; Tacoma Smelting Works, Tacoma, Wash., concrete, 18 feet inside diameter, 300 feet high.

It was originally intended to build upon this slag foundation a brick stack. However, the stack was built of concrete, according to the design of the Weber Steel-Concrete Chimney Construction Company, of Chicago.

Starting an Engine by High Explosives.

The explosive power of cordite may be utilized, says the *Westminster Gazette*, in other and more peaceful ways than that of providing the motive-power for shells. One of its latest uses is in starting heavy petrol engines from rest. A six-cylinder engine of 140 horse-power, which is being sent to America for driving the generator of an electric railway carriage, has three breech-blocks fitted to the first three cylinders. The firing of the first one starts the motor, the other two are fired at the proper time, and the last three cylinders take their charge of petrol vapor in the ordinary way. When the engine is started the breech-blocks are thrown out of action and the usual ignition appliances put in gear. This method of starting is extremely simple and obviates the trouble usually experienced in moving such a heavy engine.

[We have observed the strong resemblance of the noise at a motor race, where mufflers are dispensed with, to a sham battle; but it seems that this class of engine is now developing into artillery using high-power explosives. A little compressed air seems to us better for the purpose, however.—Ed.]

Cone-Pulley Design.

BY JOHN EDGAR.

The examples of cone pulleys we meet in practice would tend to create a feeling that it is impossible to so design them that their ratios shall advance in geometrical progression. Perhaps they were all made before this system of speeds came into vogue, or before it was considered worth the trouble to properly proportion them. There is no argument that can be presented that will show that they should be otherwise, since this is the ideal system for speeds on all styles of metal-working machinery where the cutter or work is given a rotating motion.

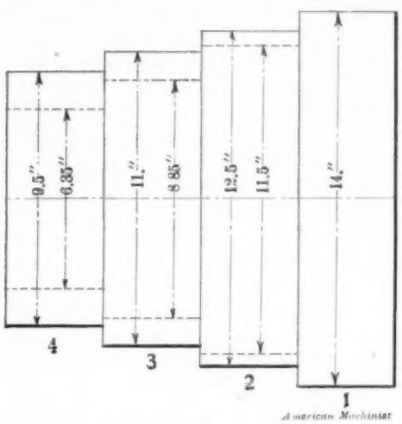


FIG. 1. TWO DESIGNS OF CONE PULLEYS.

There are several methods by which we may arrive at the desired result, but the one here given will show itself to be about as simple as one could desire.

The driving cone on the machine and the one on the counter are in most cases made from one pattern. It is generally required to proportion the various steps so that we may obtain speeds of a given number within a given range. Let us take as a simple case a four-step cone, driven at two different speeds from the countershaft, the lowest speed to be 68 and the highest 420 revolutions per minute, the speeds to be in geometrical progression. In order to find the intervening speeds, we must have their ratio, which may be found from formula

$$r = \sqrt[n-1]{\frac{l}{a}} \qquad (1)$$

when r is the ratio of one speed to the one succeeding, n is the number of speeds, l the last or highest speed, and a the slowest speed. Logarithms must be brought into play in the solution of this formula, which, when expressed in terms of logarithms, is:

$$\log\ r = \frac{\log.\ l - \log.\ a}{n-1} \qquad (2)$$

Applying this to our example, we get:

$$\log.\ r = \frac{\log.\ 420 - \log.\ 68}{7}$$

$$= \log.\ 1.30\ \textit{nearly}.$$

From this we may develop the whole series by multiplying 1 by 1.30, the product by 1.30, and so on. The series to 8 places is 1; 1.30; 1.69; 2.20; 2.85; 3.72; 4.84; 6.30.

The conditions of the problem make it necessary to divide the series into two groups, the arrangement depending on whether we make the change in the speed of the countershaft, after having shifted the belt on the cones over the four steps, or whether we change the counter speed after each shift of the belt. Since the former method is the general one, and is considered the best, we will begin with this arrangement. The arrangement is shown in Table 1.

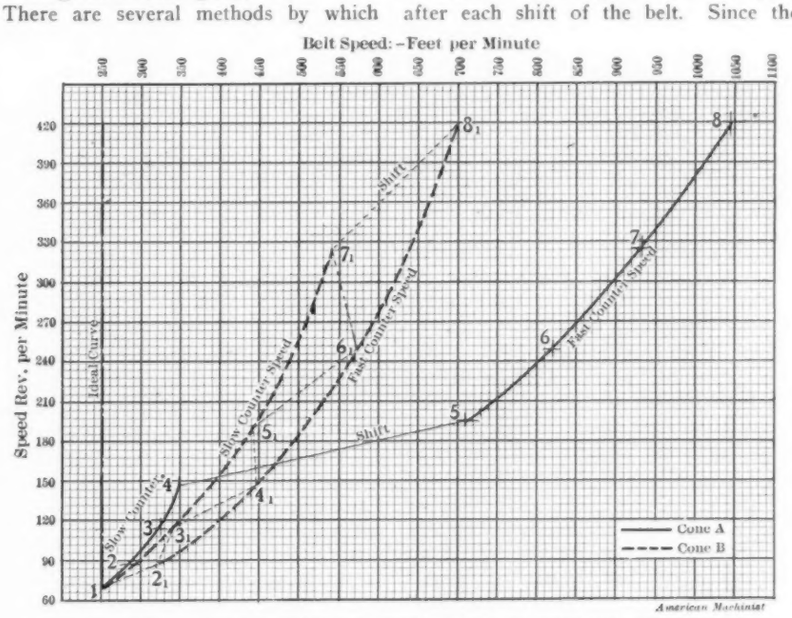


FIG. 2. RESULTS FROM THE TWO DESIGNS OF CONE PULLEYS.

From the table we see that the countershaft must have two speeds, the faster of which must be 2.85 times the slower. It also becomes evident that the speed ratio of the two extreme steps must be 2.20 to 1. Let us suppose that the largest step is given—14 inches—and since both cones are alike, we have, when d is large diameter and x is the small diameter, the total speed ratio expressed by

Cone A.	Speed Ratio.		Speed, Rev. per Min.	
	Slow.	Fast.	Slow.	Fast.
Step No. 1.	1.00	2.85	68	192
Step No. 2.	1.30	3.72	88	250
Step No. 3.	1.69	4.84	113.6	324
Step No. 4.	2.20	6.30	147.3	420

TABLE 1.

$$R = \frac{d \times d}{x \times x} \text{ or } \frac{d^2}{x^2} \qquad (3)$$

$$\text{or } x = \sqrt{\frac{d^2}{R}} \qquad (4)$$

where R is the ratio of the first and last speed of the cone for any given counter speed.

Therefore the small step of the cone in our example is:

$$x = \sqrt{\frac{14^2}{2.20}} = 9.5 \text{ inches.}$$

In order that the belt may run on any of the combinations of steps, we must hold to a given belt length, or, in other words, the combined diameters must have the same sum for any position of the belt, and this sum is 14 + 9.5 = 23.5 inches.

The ratio of the small step on the counter cone and the large step on the machine cone is $\frac{9.5}{14}$. The ratio of the second speed to the first is 1.30 to 1, and since $\frac{9.5}{14}$ is the ratio of steps for the first speed, their ratio for the second speed is $\frac{9.5}{14} \times 1.30 = .882$. We have, as their combined diameters, 23.5 inches, which must be divided into two parts, having a ratio of .882 to 1; therefore $\frac{23.5}{1.882} = 12.5$ (nearly), which is the diameter of the large middle step, and 23.5 — 12.5 = 11.0 inches is the diameter of the small middle step.

The cone is shown by the full lines of Fig. 1, and we will call it cone A.

Had we followed the second method of arranging the speeds—that is, by changing the counter speed between each change in the belt position—we would have the arrangement shown in Table 2.

Cone B.	Speed Ratio.		Speed, Rev. per Min.	
	Slow.	Fast.	Slow.	Fast.
Step No. 1.	1.00	1.30	68	88
Step No. 2.	1.69	2.20	113.6	147.3
Step No. 3.	2.85	3.72	192	250
Step No. 4	4.84	6.30	324	420

TABLE 2.

Here we see that the ratio of the counter speeds is much reduced, being only 1.30 to 1, while the maximum ratio of cone speeds on a given counter-speed is

much increased, being 4.84 to 1. This is the point on which many raise their objection to this arrangement of speeds, claiming that more power is obtained with the former arrangement. The real purpose of this article is to show this to be otherwise.

It is true that the maximum power is increased, but the extra power is only on the high speeds, where it is of no advantage. The most economical arrangement would be one where the power delivered to the machine would be constant, giving a high pull constant for low speeds, gradually decreasing as the speed increases. Such a result is accomplished with the constant-speed belt drive, which is becoming so popular.

In Fig. 1 the dotted lines represent the diameters of a cone designed according to the latter arrangement, and we will call it cone B.

If we take the slow counter speed, in the case of cone A, at 100 revolutions per minute, the fast speed must be 285 revolutions per minute and the spindle speeds would be as shown in Table 1. The countershaft speeds for cone B, in order to obtain the same spindle speeds as in case A, would be 147 and 191 revolutions per minute, and the spindle speeds would be as recorded in Table 2.

An inspection of Fig. 1 shows that the four lowest speeds are taken off of larger steps on the spindle or machine cone for the cone B than for cone A, and since they (the speeds) are the same for both cases the belt speed is greater for the former than for the latter case, which, since the power transmitted by a belt is directly proportional to its speed, means more power for cone B than for cone A on the speeds mentioned. Of course the power for the higher speeds is diminished in the case of cone B over what it would be for cone A, but, as before stated, the power is not so necessary on these speeds as on the aforementioned.

The difference in the two cases may be shown to better advantage by a diagram showing the relation of the spindle speeds to the belt speed in each case, as in Fig. 2, where the full heavy line represents the case of cone A and the heavy dotted line that of cone B. The shift from one counter speed to the other is indicated by a light line in each case. The speeds have been numbered from the lowest up. The curve for cone B approaches much nearer to the ideal than that for cone A, and shows an advantage for cone B not mentioned before, and that is the ease with which the speed may be changed, as from 4 to 5, where it is done in cone B by shifting one step on the cone, but on cone A we must shift the full range of the steps.

I find it a decided advantage to use a diagram such as that given in Fig. 2 when designing drives, since it shows at a glance what we may expect from any individual case, and also shows up the defects in such cases as cone A.

The method given for figuring the diameters does not take into consideration the variance due to center distance, but should this become very short the correction may be made after the figures for correct diameters, so far as the speeds are concerned, are obtained. The difference caused by the short center distance will not seriously affect the result desired.

When the range of speeds is large and the diameter of the large step small, it will become impossible to use cone B, and in such a case back gears would have to be resorted to. In cases where back gears are used, the tabulated values of the ratios, as in Tables 1 and 2, will be of great value in proportioning both cone and gears, and a diagram such as the one given will surprise many with its irregularity.

Child Labor.

The secretary of the National Child Labor Committee, of 105 East Twenty-second street, New York city, in a recent publication states that at least 2,000,000 children under sixteen years of age in the United States are employed for wages, most of whom ought to be in school. Child-labor laws lack uniformity in different States, and many of them are only crude beginnings at legislation; nearly all are poorly enforced. Several States and Territories have no legal protection for children. A very decided influence has been exerted by the organization of the National Committee upon the officers charged with the enforcement of child-labor laws, who often appeal to the society for advice and assistance, and who know that they will be supported against unfriendly political influences when do their duty, and freely criticized if they do not.

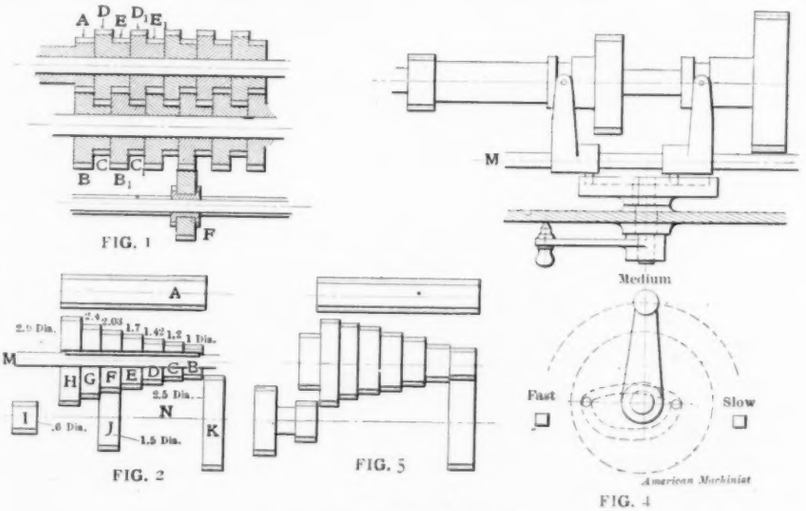
No work could well be more commendable than that which tends to prevent children of tender years from being shut up in factories or made to do the work of adults.

Gear-Box Drives.

BY H. T. MILLAR.

Now that the constant-speed belt is being boomed, all sorts of change-speed devices, good, bad and indifferent appear. The chief claim of some to notice lies in the large number of changes obtainable, others in the small number of gears in the motion, though, may be, all of them revolve.

As an object lesson of what to avoid in design, Fig. 1, for which a German patent was granted recently, may be noted. All the gears, excepting *F*, run loose on their shafts. They are cast or otherwise made in pairs; *B C, B_1 C_1, D E, D_1 E_1, etc.* Gear *A* receives the power from outside, and the different speeds are obtained by gear *F*, which is splined to its shaft, being slid into gear with *B* B_1 B_2 B_3, etc. *A* drives *B*, *C* drives *D*, *E* drives B_1, etc., reducing the speed by a fixed ratio as it proceeds. It is evident that before many changes can be obtained a considerable number of gears are in mesh and every wheel between *F* and *A* revolves under load, consequently wasting much power.



GEAR-BOX ARRANGEMENTS.

One might divide change-gear motions into four general types, those with sliding keys, sliding wheels, clutched wheels, or some combination. The sliding key type has some advantages; it is economical in space and may be changed while the work is in motion, but I am not very partial to it. It is, as generally made, liable to get out of order. Also all gears in the train revolve, some of them idly, it is true, but it is the idle wheel, not the loaded one, that makes the most noise. Clutches alone may be used where the number of changes required is small. For reliability and simplicity I prefer the sliding-wheel type.

It is possible to obtain twenty-one changes in geometrical progression with twelve gears and four shafts. Fig. 2 is a development of the motion, the dimensions of which show the relative sizes. It is al-

ways better to lay the gears out in this manner first, then to figure the absolute sizes in consideration of the actual requirements of the case, which may limit the size of the largest or smallest of the gears. The speed ratio is 34 to 1 and the rises are shown in the diagram Fig. 3. Wheels *I*, *J* and *K*, Fig. 2, gear with corresponding wheels *H*, *F* and *B*. *I*, *J* and *K* are mounted on a splined shaft, which is the final shaft of the motion. The connection between pinion *A* and the train *B C—H* is made by the ordinary sliding wheel and tumble shaft, not shown. the third shaft of the motion *M* has seven speeds of revolution, corresponding to the gears mounted on it. For each of these the final shaft *N* has three, obtained by putting either *I*, *J* or *K* into gear. Obviously only one of these must be in mesh at a time, and it is an advantage to have only one handle to move them. If two handles are used they must be interlocked. After spending some little thought, the only cheap solution appeared to be a cam. The details of the arrangement are shown on Fig. 4. The stirrups slide loosely on the rod *M*, and are moved by the pins running in the cam, which turns half a revolution.

Returning to Fig. 2, the dimensions of the gears *B C—H* rise in geometric ratio and need no comment. The method used for obtaining the sizes of wheels *I* and *K* on the slide rule may be worth recording. The runner is brought to the highest ratio required—in this case 12 to 1 (see Fig. 3) —on the A scale. The size of gear *H* then being noted also on the A scale, either with another runner or mentally, the slider is then manipulated until two numbers come opposite the two previously noted, such that *H* and the number opposite to it equal the number opposite the ratio plus one. When the diameters of *I* and *K* are known the finding of *J* is simple.

It is evident, however, that with some rises it is impossible to obtain a correct ratio between *F* and *J*, having to keep a fixed center distance, and Fig. 5 shows the obvious remedy. In a similar manner four pairs of wheels could be used, giving four changes for every speed of the shaft above. The wheels on the driven shaft would need to be coupled together in pairs and moved in and out of mesh by a cam, or a pair of interlocking segments to be described later.

When there are only two gears on the driven shaft, as on the Brown & Sharpe gear cutter, shown at page 855, Vol. 28, Part 1, the segment *A*, Fig. 6, provides a neat method of moving the "slow and fast" gears. As is evident from the sketch it moves one gear out of mesh before putting the other in, and prevents the breakage which might occur through leaving both gears half in mesh. It also enables the gears to be put in while in motion if necessary. The rings *R*, kept from revolving by a rod passing through eyes at the back of the shaft, have semi-circular pins set in them. Starting at the top sketch, the ring R_1 is moved endwise until the pin *S* comes out of the recess in the segment. At that time the end of the segment comes in contact with the other pin *T*, moving it along; the pin *S* being now clear of the segment.

The great advantage of all these arrangements is that no gear is in mesh except those actually doing the work and the number of these is kept to a minimum.

To work these motions, however, the box should be easily reached, which is impossible in some cases; for instance when on the back of a lathe or the top of a planer upright. In this case, if the speeds shown in Fig. 8 are near enough to correct progression, the layout of Fig. 7 might be recommended. It is impossible to obtain absolutely correct rises, but those shown are thought to be near enough for the majority of purposes. As shown there are eighteen changes with a ratio of 34 to 1 — similar to the one selected for the previous case. The three wheels keyed on the left-hand end of shaft *G* are stationary endwise. The sliding wheels *C B A* and *D E F* are moved on their shafts by cams laid out on both sides of plate *P*. Lever *R* fulfils a double purpose; it acts as an index for the nine different positions of the cam plate and it also stops the gears before any change takes place. When the plate is turned, it lifts lever *R*, which is connected by a shaft to clutch *S*. The clutch *K* puts in either the slow or fast gears. If the motion had to be placed in an inaccessible position a bevel or other gear could be mounted in place of the handle, and connections made by shafts to some convenient position.

It is well to notice that the wheels in this motion should have varying widths. Each wheel has a different periphery speed and consequently a different load

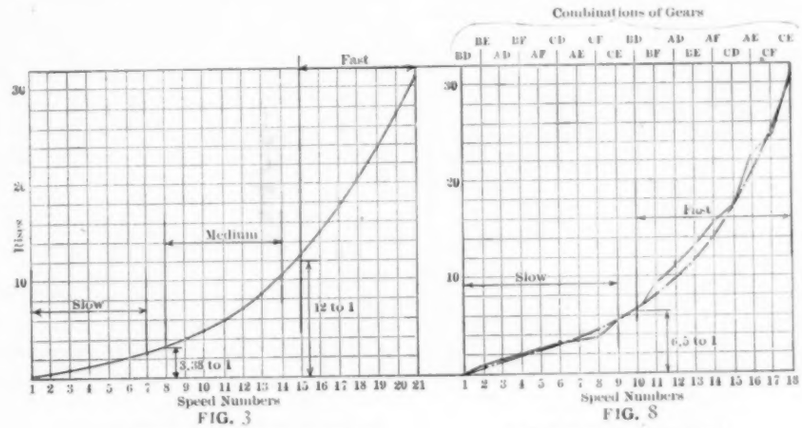


FIG. 3 ARRANGEMENT OF FIGS. 2 AND 5.

FIG. 8 ARRANGEMENT OF FIG. 7.

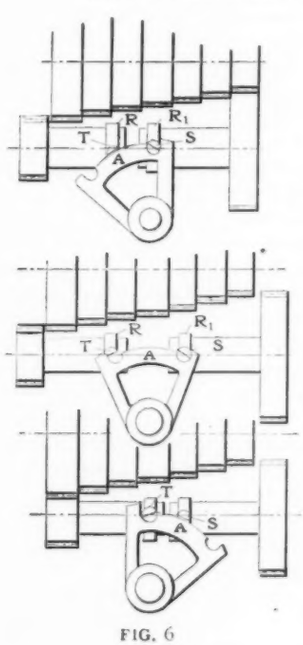


FIG. 6

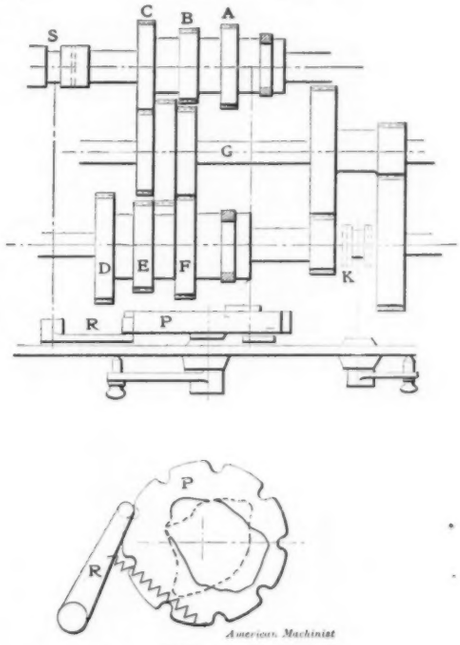


FIG. 7

GEAR-BOX ARRANGEMENTS.

on the pitch line. I have seen cases in which the advantages of the constant-speed belt have been extolled, constant power at any speed, etc., etc.; even when attached to a box in which the gears were not capable of transmitting a constant amount of power.

Manchester, England.

Tests of Brass Furnaces.

The table of results of tests presented herewith was sent us by George Perrott, foreman for the Canadian General Electric Company, at Peterborough, Ont., who says: "I read with interest a description of the 'Charlier' oil furnace, at page 276, and, having reliable statistics of a competitive test of a similar furnace, I enclose you particulars, which I trust will be of interest to your general readers, and should be of considerable value commercially to producers of brass alloys."

COMPARATIVE TEST MADE WITH THE "CHARLIER" AND "SCHWARTZ" BRASS FURNACES.

The oil used was measured with a meter, and the tests on the different furnaces were run on separate days in order that the same meter might be used on each. The metal was weighed into the furnace and was weighed out while hot, before being poured into the molds, so that no opportunity was afforded for any being lost.

Below is a tabulated report of the comparative performances of the two furnaces:

	Charlier.	Schwartz.
Total time of tests.....	9 hr. 37 m.	16 hr. 2 m.
Total number of heats....	9	7
Av. length of each heat....	1 hr. 4 m.	2 hr. 17 m.
Av. time metal was under blast.....	51 m.	2 hr. 9 m.
Av. weight of metal charged per hr.....	670.5 lbs.	323.7 lbs.
Av. weight of metal delivered per hr. by furnace	649.4 lbs.	293.0 lbs.
Oil consumed per 100 lbs. of metal delivered.....	2.29 gals.	2.68 gals.
Av. shrinkage in all kinds of metal.....	3.13%	9.48%
Av. shrinkage in chips....	4.9%	14.7%
*Av. shrinkage in soft brass	5.5%	5.9%
Av. shrinkage in special mixtures.....	1.7%	3.6%

*Note.—33% spelter used.

TESTS OF THE "CHARLIER" AND "SCHWARTZ" BRASS FURNACES.

We have received from the Department of Commerce and Labor at Washington, No. 60 of the "Bulletin" of the Bureau of Labor, which is devoted to an exposition of the subject of government industrial arbitration. The record presented is not confined to that which has been done here, but covers practically the entire industrial world, and the "Bulletin" is a valuable collection of what has been done along the lines of industrial arbitration and conciliation. It should be in the hands of all who are interested in this subject, and we assume can be obtained by anyone who applies to the address given above.

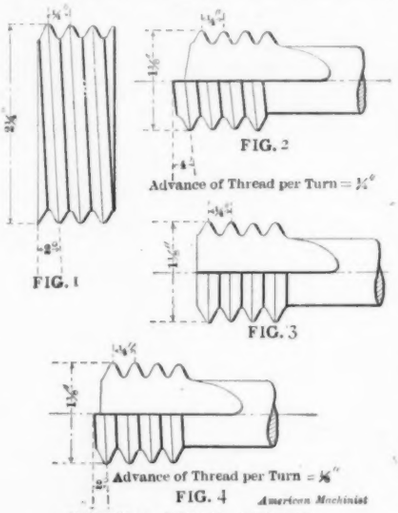
The S. S. "Carmania"—sister ship to the "Caronia"—left Liverpool, December 3, for New York. She has three propellers, driven by turbines.

Letters to the Editor.

Internal Thread Chasers.

I am interested in anything relating to circular thread chasers, and read with pleasure the article by "Nomad," at page 506. Such tools as he illustrates are of course widely known, and in some places are quite extensively applied, but there has always been a serious obstacle to their use, particularly for the coarser pitches.

In the sketches herewith, Fig. 1 shows a 2¼-inch diameter screw with four threads per inch, and the angle of the thread by calculation, is almost exactly 2 degrees. Fig. 2 shows a 1⅛-inch diameter screw also with four threads per inch, and the angle of the thread is 4 degrees. A groove is shown as having been cut in the screw, to form the cutting edge of a chaser, and the half threads at the ends have been removed, after the groove has been made,



INTERNAL THREAD CHASERS.

by pulling the lathe round by hand with the wheels still set for four threads per inch. If a chaser were made like Fig. 2, it is evident that it would not be right for cutting a nut to suit the screw shown in Fig. 1. The chaser would rub on one side of the thread, and would have excessive clearance on the other side; and I would point out that no chaser can ever be correct (for single-threaded nuts), if made in the usual way in a screw-cutting lathe, that is to say, if the threads form part of an ordinary screw thread, because the angle of the thread on the chaser cannot then agree with the angle of the thread in the hole. Obviously any chaser that is only a screw with a groove cut in it (whether the groove is cut first or last, of course, makes no difference), must always have the thread at too great an angle, for the chaser is smaller in diameter than the hole to be chased, and yet the thread advances by an equal amount per turn. For this reason, right-hand chasers, shown in Fig. 2, rub or tend to rub on the side of the thread next the shank.

Frequently it is actually better to make the chaser without the thread being at an angle at all. Thus a chaser made like Fig. 3, with circular ridges simply turned on it, would tend to rub, on the side of the thread away from the shank, but it would be just as suitable (or unsuitable) for cutting four threads per inch in a hole 2¼-inch diameter as a chaser made like Fig. 2. In one case the angle of the thread is too small (there being in fact no angle), and in the other case the angle is too large. Both chasers are unsuitable for the work, the faults being equal in amount, but in opposite directions; but as the diameter of the nut to be cut is increased, it will be observed that the error in using chaser No. 3 becomes less, until in a hole, say a foot or more in diameter, the error would not be of any consequence, but on the other hand, chaser No. 2 becomes more and more unsuitable as the increase in diameter reduces the angle of thread in the nut.

In many cases the discrepancy between the angle of the thread on the chaser, and in the nut, is not sufficient to appreciably affect the work, but I may say that I have frequently seen the fault of using a chaser like Fig. 2, when Fig. 3 would have been more suitable, but I have never noticed the opposite mistake of using Fig. 3 instead of Fig. 2.

The whole difficulty may be compromised, however, by making the groove for the cutting edge first, and then cutting the thread so that it shall advance about half its pitch in one turn as shown in Fig. 4. The thread so made is half-way between a regular screw thread, and a simple turned ridge. In the case illustrated, the angle of the thread is the same as in Fig. 1, and this chaser would be perfect for cutting a nut 2¼-inch diameter four threads per inch. Chasers like this may be made by using a four thread external chaser in the screw-cutting lathe, with the wheels set for eight threads per inch, but, of course, when the external chaser lands in the groove after each turn, it is necessary to re-adjust it to take the next cut, and such a method would be tedious, and would only be thought of for making single odd chasers.

A few years ago I patented this form of chaser, and am manufacturing them regularly for the market. Making in quantities, I use cams to move the slide rest at the necessary rate to give the correct angle of the thread, and to move it back rapidly in the short time the chaser is in the groove. I admit that chasers like this are only correct for one diameter of nut, and there is an error if the nut is larger or smaller than this size, but then chasers made with either regular screw threads or with circular ridges, are wrong in every case, and usually much worse than the chaser I have described can ever be.

I should suppose that everybody who

uses circular chasers knows that in most cases they may be adjusted to a small extent, by tilting them over in the tool-post, but, of course, this is sometimes impossible, such as in the case of a long hole of small diameter where the shank of the chaser would be in the way, or again in the case of a turret which does not allow of the chaser being tilted. It then becomes very important to have the chaser cut with the threads at the correct angle.

Your correspondent is quite correct in saying that the top of the first thread should be removed so that it may take its cut and leave a suitable amount for the next thread to remove. In many cases the first three threads are cut in this way so that each of the four threads is in work, but this, of course, cannot be done when a thread has to be cut up to the end of a blind hole. S. N. BRAYSHAW.

Manchester, England.

The Peculiar Effect of Sea Water on Gray Iron.

Beginning with an article at page 62, there have been several contributions discussing the effect of salt water upon gray iron. There has been considerable study by marine engineers of the effect of salt water upon the hull plating and connections thereto. There is always considerable deterioration at points below the water-line, where there are composition fittings; a slight galvanic action is created, and unless means are taken to prevent it, its effect will soon be noticed upon the adjacent plating. In order to prevent deterioration, all the surrounding surfaces are protected by the use of rolled zinc plates. It has been found that cast zinc does not give as good results as rolled.

The accompanying sketches may be of interest, as well as give clearer information. Fig. 1 is of a suction or intake connection, and Fig. 2 is a discharge-connection for the same water, after being used. The materials as mentioned for the different parts have proved to give the most lasting results. The zinc protectors are secured, when first installed, by 3/16-inch diameter screws, for, as the screw and its hole deteriorate, they can be made larger and new screws put in. It will be noted that at the discharge-connection the greater area of zinc is placed on the after side of the opening, as the action of the sea-water would naturally be more upon that side when the ship is in motion.

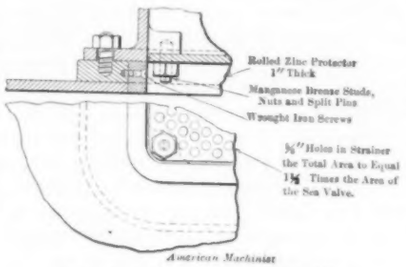

Rolled Zinc Protector 1" Thick
Manganese Bronze Studs, Nuts and Split Pins
Wrought Iron Screws
Holes in Strainer the Total Area to Equal Times the Area of the Sea Valve.
American Machinist

FIG. 1. SUCTION CONNECTION.

All strainers are made with round or square holes of about 5/8 inch diameter, as oblong holes would permit of small, flat fish passing in. When a ship is in constant service, it is necessary to renew the protectors about every six months; although they may not be entirely eaten away in that time, all useful properties will have been exhausted.

A. H. NOURSE.

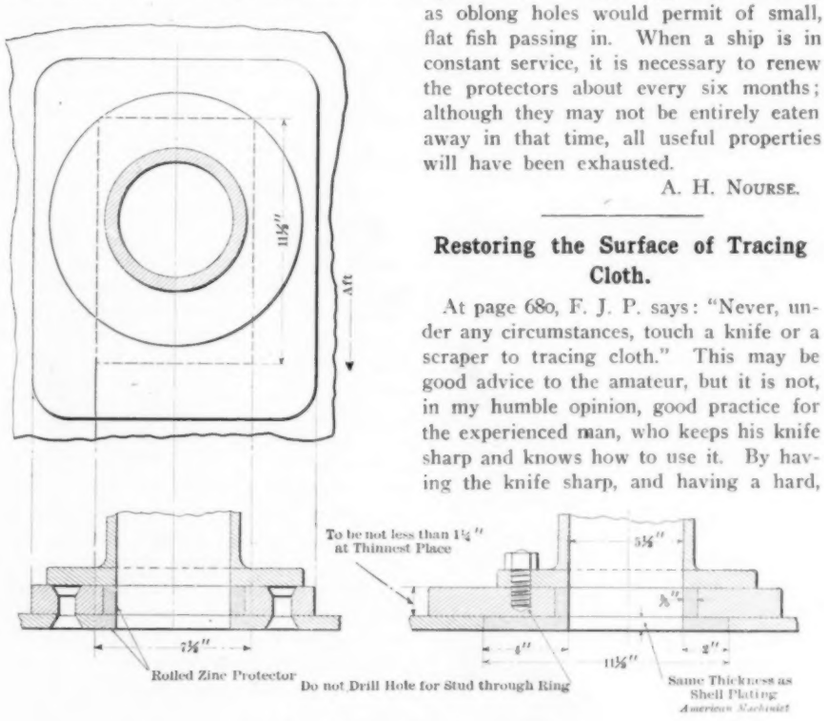


FIG. 2. DISCHARGE CONNECTION.

Restoring the Surface of Tracing Cloth.

At page 680, F. J. P. says: "Never, under any circumstances, touch a knife or a scraper to tracing cloth." This may be good advice to the amateur, but it is not, in my humble opinion, good practice for the experienced man, who keeps his knife sharp and knows how to use it. By having the knife sharp, and having a hard, smooth surface underneath the tracing, one (who knows how) can scrape away the ink line without injuring the cloth. Remove most of the ink with a sharp knife, then finish with rubber erasers as F. J. P. does, and you will get along faster and better. R. J. D.

Another Electric Object Lesson.

J. R. M.'s yarn at page 671 reminds me of one that also was given on shipboard. In marine construction large quantities of brass fittings are used. These are a constant temptation to thieves, beachcombers from the shore, firemen and sailors from the forecastle, and even engineer and deck officers irrespective of rank have been known to degenerate so far as to loot the brasswork from their own ships.

The steamship "Labscouse," of which I was second engineer, was in the China coast trade. We had lost quite a lot of brass and copper from the engine department, chiefly articles of little value, old cocks, valves, bearings, and oil piping.

The fourth engineer had been signed on because of his intimate knowledge of electricity. In the possession of this knowledge he stood alone, as none of the rest of us knew a thing about it.

We were lying at Shanghai surrounded by sampans, and a good watch was being kept on deck all night, aided by electric light, which was kept on from sunset to sunrise. These dwellers in sampans are notorious thieves, and stories are told of their having stolen chain runners off winch drums and even anchor chains—weighing many tons—out of chain lockers without being discovered.

On going on top of the boilers, the morning after our arrival, I found the safety valve on the starboard boiler had been "shanghaied" during the night and the one on the port boiler with all the nuts taken off and the joint broken, ready to take away.

Without mentioning my discovery to anyone but the chief engineer, it was decided that I should watch on top of the boilers that night and catch the thief when he returned for the second valve.

As soon as it was dark I secreted myself on top of the starboard, with a Colt .45 as sleeping partner. At 7 o'clock next morning I reported to the chief that the valve was still there. I had heard nothing but the skurrying of the ghost-like white Siberian rats as they foraged to and fro over the boiler tops.

The next night passed the same as the first, except that it was much harder for me to keep awake. But on the third morning what was my surprise in the dim gray light of the early dawn to see that the other valve was gone. I reported the loss to the chief, who swore fervently and accused me of sleeping on watch. I told him if I had slept (I was not at all sure I had) that it would be little to wonder at after being on duty most of the time for three days and nights. However, we made the best of a bad job; I made a sketch, and new safety valves were ordered from Hong Kong.

All that day I went about my work in a half-dazed condition from loss of sleep. The electric plant was in a little alcove on a level with the second platform at one

side of the engine-room. Opening off this was the storeroom. In the afternoon I was in the storeroom; as I came out with a wrench in each hand my foot slipped on the greasy grating and something happened. As soon as I had picked myself up I went to my room and sent for the fourth engineer. Without letting him know my object I got him to tell me all he knew of the gentle art of electrocution. This done, I dismissed him, and taking two firemen went to the storeroom and got a spare six-inch brass stop valve that had been left on board by the people who had done the pipe-fitting. This we took to the top of the starboard boiler, where I made a great show of being surprised that it would not fit the studs which had held the safety valve. Several planks were secured and a substantial platform built for us to stand on. Finally a small sheet of iron about two feet square was placed on the platform in such position that anyone working at the valve must stand or sit upon it.

About 5 o'clock the third engineer came and had a look. A few minutes later I heard him tell the fourth that I had evidently gone daft, as I was trying to replace one of the stolen safety valves with a common stop valve that was two inches too big to go on the studs.

I swung the valve around, entered one of the studs and tightened the nut, remarking to the firemen that we would file the holes to fit in the morning, as it was time to stop work.

About 9 o'clock that night I crept cautiously below and ran a wire to the stop valve and another to the sheet of iron on the platform from the deck circuit. At 2 in the morning I was awakened by a series of blood-curdling yells from the stokehold. I made one spring below, clad in my pajamas, and threw the switches for the lights for the engine-room and stokehold. In the starboard alleyway I found the culprit paralyzed with fear, resulting from his encounter with the "juice" and his twelve-foot fall from the boiler top.

Under pressure he confessed, and we found the safety valves, uninjured, hidden in one of the bunkers. The watch on deck had been so rigid that he and his mates had been unable to take them ashore. The order for new valves was countermanded by telegraph.

Thereafter nothing was stolen, but we had great difficulty in getting the men to go on top of the boilers; in fact, they positively refused to go unless accompanied by an engineer. The chief and I kept the joke to ourselves, and the other engineers attributed our catching the man to his fall only. The fireman, however, swore that he had no sooner put his wrench on the nut than a wild-eyed banshee struck him with a flaming sword and knocked him off the boiler. I suspect he got the same thing that I did when I came out of the storeroom with the wrenches and accidentally made a circuit when I slipped on the grating. DIXIE.

The Demand for Engineers.

Your editorial at page 746 brings out a point that has never, I think, been clearly enough stated, that the college-bred man fits very nicely into the commercial engineering positions. So much has been written and said on technical training that it is like beating chaff to attempt any exposition of the subject. In any discussion so much depends on the point of view and premises taken, that it might be well to say that I look at it from the standpoint of a member of a large organization, using mechanical and electrical engineers in a manufacturing business.

The point made is a good one and works out in practice. The main aim of a technical education should be two-fold. First, to increase the mental efficiency, so that the student can think clearly, quickly, correctly and concisely; second, to develop character along general lines, and produce a personality that shall command respect. What facts, theory, and formulas are absorbed are incidental and largely useless, because a man must specialize these days, and only about 1 per cent. of his theory can apply to his job. These qualities an executive must have, and added to a fair mechanical head, a good executive may be made from the average college man.

There are, however, one or two other qualities without which no man can become a great engineer. The first is power of invention, and that is something that cannot be learned, but must grow from within. The second is self-reliance, true self-reliance based on victories won, not on mere expectation of future victories. The first is in some measure hereditary. Nearly every first-class engineer, that is, of course, mechanical engineer, comes from a mechanical family. As the average college man comes from a well-to-do family of necessity, we at once cut out nearly all the sons of our machinists and skilled workers. The average lad of mechanical bent would prefer to run a crane than study, and he generally does.

The case against the college man, however, turns largely on the one question. Does a technical course teach a man to rely on himself? and I think the answer is, no. Put any animal to walking a beaten path, and the rough going elsewhere is distasteful to it. The college man relies on his looks, his theory, and precedents; the practical, common or garden variety of engineer, on himself. Where the college man can see a park landscape well laid out, with smooth paths and well ordered lawns, the poor untutored mechanic sees only a rough wilderness, without plan or pleasant going, and if he has the courage to break through all this tangle, he gains courage and belief in himself, that is denied to his more fortunate fellow who saunters along the pleasant paths. The college man may sniff at my pleasant paths, but there can be no comparison between the life of the fellow who files brass and shovels the chips out of the screw-machine pan, and the lad who kicks at an hour a day over the drawing table. It may be hard work "boning mathematics" with the task laid out and help at hand, but how much harder it is to tackle the same subject all by one's lone self after putting in ten hours in shop.

What we want in business is a man who keeps his ears clean, and who can deal with his fellows. He must be able to handle correspondence, have a great deal of tact and a good general engineering knowledge. If he will work and get familiar with our product and methods, he can make a comfortable salary. He is not an engineer, but if he minds his business and behaves he can be the engineer's boss.

But for engineering work, the man whose finger-nails are worn down to stubs from handling tools, is the man for us, provided he has been able by dint of burning much midnight oil to learn that calculus is only another name for horse sense, and that the average college graduate doesn't remember enough of it after he has been out of school three years to figure out the point where his salary curve parallels the abscissa. F. W. HARRIS.

Flagging the Belt Man.

I was interested in a scheme I noticed the other day in one of our large shops, which consisted in arranging sign-holders to project out over the aisles, the sign up, as I passed, reading, "Belt Man." They also have such signs as "Carpenter," "Electrician," etc.

It often happens that there are needs of the kind attended to by these men which are not pressing, and the company keeps several steady, reliable men circulating through the shops finding work for themselves. The signs are like the "Ice" wagon signs that are hung out, and the man knows if his services are needed, right away. F. W. HARRIS.

Brazing Gray Iron.

At page 682, G. H. N. states that gray iron can be brazed with common brass and borax, heating the piece sufficiently to melt the brass. As this is erroneous and apt to be misleading to many young mechanics, it is no more than fair to state, that while there is a process and possibly many different ones to braze gray iron, it cannot be brazed in the usual way or the same as wrought iron, as the brass will not unite to gray iron owing to the presence of free carbon in the latter.

G. V. HUBER.

Prony Brake Datum—Erratum.

By the dropping of a decimal point E. H. Waring was made to say, at page 740, that the constant for a water-cooled brake is "about 1 square foot per horse-power." For this read *about .1 square foot.*

Meeting of the American Society of Mechanical Engineers in New York.

In accordance with the program previously printed in our columns, the fifty-second meeting of the American Society of Mechanical Engineers convened in the auditorium of the Edison Building in Twenty-seventh street, New York, Tuesday evening, December 5. It was at once apparent that the more commodious and altogether admirable quarters secured by the Meeting's Committee would be needed during the meeting, as, before the first fall of the president's gavel, over 700 had been registered, and it was apparent that the attendance would probably reach over 1,000 and would be the largest in the history of the society.

After the usual greetings of friends and the pleasant social time which precedes the formal proceedings, the meeting was called to order by President Freeman, who delivered his Presidential Address on the subject of

The Saving of Lives from Theater Fires.

It became evident, as the delivery of the paper progressed, that Mr. Freeman had had special opportunities for studying this subject, and his paper was extremely enlightening and interesting. He had been called by a prominent manufacturer in Chicago, who had lost two nieces in the Iroquois Theater fire, to examine into that fire, and to see what measures might be taken to prevent such calamities in the future. He described in considerable detail the defects of theaters as they are now usually constructed; declared that the means adopted for preventing and controlling fires in theaters were to-day from fifteen to twenty-five years behind the practice of manufacturing establishments in that regard, and that many of the features that are found in even the most modern theaters would not be tolerated for a moment in any well regulated factory. He declared that the fire risk in theaters was to-day about ten times as great as that in a well constructed and well looked after manufacturing establishment; and that all of it was entirely needless, though, of course, it means that there is a corresponding risk of loss of life, to say nothing of the destruction of property.

The speaker called attention to the fact that a theater with its proscenium arch is virtually a room with an immense fireplace at one end of it; that if, above this fireplace, a chimney is constructed—that is to say, if there is clear opening from the stage to the top of the building, forming a sort of chimney through which smoke, the gases of combustion and flames may freely emerge, and if this chimney has an area of from one-tenth to one-eighth of the area of the proscenium arch opening—little or no harm will come to the audience from any fire which is likely to break out upon the stage; but in order to make it so, the devices for opening the dampers must be constructed by engineers upon engineering principles, not as a carpenter or a tinsmith or both combined would design and construct them.

Asbestos curtains were discussed and much light thrown upon their value, or rather lack of value. Extensive tests, conducted under the direction of the speaker, and records of tests made by others here and abroad, were given; the general result being that asbestos-canvas curtains had been found to be entirely unreliable; the asbestos used to-day for that purpose containing usually considerable combined water, which at moderate temperatures is driven off, disintegrating the fibers of the material and so weakening its cohesive properties that it falls to pieces. Tests had also been made with such curtains having fine wire gauze woven into them. These were little, if any, better; the wire being composed largely of zinc, which was speedily fused out, and the wire thereby so weakened as to serve no useful purpose. Steel curtains lined with asbestos and properly mounted had been found to be good for the purpose designed, and were recommended where constructed and hung under competent direction.

An interesting and somewhat amusing part of the discourse related to the so-called fire-extinguishing devices, which contain powder to be scattered over the fire. These had been found to consist of common carbonate of soda, such as is used in our kitchens; sometimes mixed with a little coloring matter, evidently to conceal its real character, and occasionally with a little starch or fuller's earth to prevent caking. The cost of the material in these tubes, including the tubes, would be probably about 10 cents. They are usually sold at $3.00, and, the speaker declared, were practically worthless for purposes of fire extinguishment. The speaker gave a long list of names of such fire extinguishers, and declared that they were all of the character described above.

He also related an instance of a certain hand grenade it was claimed had been adopted for use on United States naval vessels. The liquid contents of this grenade had been analyzed and found to consist of salt and water. Afterward, at St. Louis, the speaker had seen grenades of the same make hanging in the naval exhibit there, and his conclusion therefore was that possibly the *United States Navy had really paid about a dollar a quart for salt water* with which to protect its vessels from fire.

The subject of fire prevention and fighting in theaters might seem at first glance to be little related to mechanical engineering, but the speaker treated it from the standpoint of the mechanical engineer, and in a way to more than justify its presentation before such a body as the American Society of Mechanical Engineers. The address, however, ought to be widely circulated. The public should be educated as to the facts contained in it, and public sentiment should be aroused to such an extent that the precautions detailed in this paper would be adopted in every auditorium in every civilized country. It is a matter of a little expense, but not altogether of expense, but in addition some intelligence and some of paying heed to the lessons of experience; many of these lessons having been in the hideous form of the quick destruction by fire and smoke of hundreds of men, women and children.

Wednesday Morning Session.

The committee of arrangements had provided a unique feature for this session, the holding of it on board the Hamburg-American liner "Amerika," as she lay at the company's docks at Hoboken. The hour set for the opening of the session was 10 A. M., but interest in the great vessel caused the members to assemble long before this hour. Officers and employees of the company were on hand to direct sight-seeing parties, whose interest was so great that the session did not open until half an hour after the time set.

The session was held in the main saloon of the ship, and was opened by President Freeman, who invited Emil Boaz, general manager of the line, to deliver an address of welcome. Mr. Boaz briefly traced the history of the company from the time when it owned but a single sailing ship, and he added emphasis to its stupendous growth by stating that, except for two years when it had two steamers in the far eastern trade, it had never received a cent of subsidy from any source.

Following this address came the

Annual Report of the Council.

Aside from those things with which our readers have been already made familiar, the report of the Council states that in January the mortgage was executed by the trustees upon the real estate for the new building, covering the sum of $541,000, and in July the contract for the construction of the building was made, the foundation piers for it being in an advanced state at the time of the preparation of the report.

From the report, it appears that the property of the society, 12 West Thirty-first street, New York, which was originally purchased at $60,000, has now risen to the value of $125,000; offers for it at $115,000 having been declined under competent advice.

The regulations under which local sections or branches of the society may be organized are given in full, these being the rules which, after their promulgation, caused the Milwaukee branch to dissolve as such and become a local engineering society; which is indicative of the course

which will probably be usually pursued by those who wish to organize local associations of engineers.

A simplification of the business of the society has been brought about by the appointment under advice of the Finance Committee of a Cashier, who has been placed under $5,000 bonds, and who, on the order of the Finance Committee, makes individual payments to those with whom the society does business; the Treasurer handing over to the Cashier such sums as may be needed for this purpose, also under the direction of the Finance Committee.

Upon the recommendation of the Committee on Membership, a form of application blank has been approved by the Council, which blank calls for a more detailed statement of professional achievement, by candidates, and for a statement of the work actually accomplished in the positions which such candidates have held. The new blanks will be distributed to the members with the next issue of the year book.

The report of the Finance Committee, which is incorporated as a portion of the report of the Council, will be read with great interest. It is full, complete, clear and satisfactory. From it any member can easily ascertain the exact status of the society with respect to its finances, and it bears the endorsement of the Audit Company of New York, whose experts have examined the books and have certified to the correctness of every statement made in them and in the report, as presented. The report shows that, whereas for the fiscal year 1903-04 the expense account exceeded the income by $2,005.17, for the year 1904-05 (covered by the report) the income exceeded the expenses by $1,450.61, making a net gain of income over expenses of $3,455.78.

The excess income earned from all sources per paying member over the expense incurred for all purposes per paying member was, for the year, 92 cents; while the excess expense incurred for all purposes per paying member over the income earned from dues alone per paying member was $1.06.

The total assets of the society in excess of its liabilities increased during the year by $9,400.44, and that is without taking into account the increased valuation of the society's house, previously referred to, which is still carried upon the books of the society at a valuation of $85,000, instead of the greater sum its established value would seem to warrant.

For the coming fiscal year it is estimated that there will be an excess of receipts over expenses of only $158; but as in the statement of estimated receipts, only those sums which, under the rules, are available for operating expenses are taken account of, the real showing is better than that by nearly $5,400, which amount, if received, will, under the rules, be set aside or invested.

Following the report of the Council came the report of the tellers of election, following which President Freeman appointed ex-Presidents Fritz and Wellman a committee to escort President-elect Taylor to the platform.

Mr. Hunt was then called upon for a report of the committee on the Carnegie Union Building, and he replied by saying that the expectation is that the building will be ready for use at the next annual meeting.

Mr. Suplee was then asked for a report for the committee which has in charge the preparation of a history of the early years of the society, and he replied by saying that much material had been gathered, and that the committee expected to have its report in type for the next anual meeting. The business session was then brought to a close by the presentation and discussion of the

Report of the Committee on Standard Proportions for Machine Screws.

This report is the outgrowth of a paper read before the Society some years ago by C. C. Tyler, in which attention was called to the chaotic condition of our small machine screws. The committee consists of Wilfred Lewis, chairman, Charles C. Tyler, Horace K. Jones, John Riddell, George R. Stetson, George M. Bond, who acted in concert with several machine-screw manufacturers. The thoroughness of the report is indicated by the fact that it discusses and decides upon the following details which the committee believe to be essential in establishing and maintaining the desired standards:

Form of thread.

Diameters.

Number of threads per inch.

Standard reference thread gages, basic and for screws and taps.

Working gages for screws and for taps.

Limits of variation, measured in the angle of the thread.

Limits of variation in external diameter.

Limits of variation in the pitch of thread, screws and taps.

Proportions of the heads.

The Sellers form of thread is adopted, except that the screws and taps are to be so made that the threads will clear one another at top and bottom, the bearing being only on the sides, as it should be. The range of sizes is from and including .07 to .375 (3/8) inch, and it thus overlaps the Sellers sizes between 1/4 and 3/8 inch. The latter size has the same number of threads as the Sellers standard, but the smaller sizes are finer as they should be. It is well known that the smaller sizes of Sellers threads are not used to nearly the extent of the larger ones, and we cannot but think that this is a very favorable oportunity to revise the smaller Sellers sizes for bolts and to adopt those which people will use and to make the sizes for bolts and screws uniform.

To carry out the clearance of top and bottom idea, the committee adopts Mr. Tyler's suggestion, and recommends three sets of reference gages—one basic, one for screws and one for taps—and, with slight modifications, other recommendations of Mr. Tyler's are adopted.

Detail engravings of these master gages are given, and the form of working gages is also determined. Recognizing the necessity for variation in the sizes of manufactured screws, limits of variations for taps and screws are established by formulas and exhibited by enlarged diagrams. Complete tables of these limits are also given, the report concluding with tables of recommended standards for round, flat fillister, oval fillister and flat heads.

The report was discussed at considerable length. Mr. Neff and Mr. Burlingame referred to the practice of the Brown & Sharpe Manufacturing Company, and objected to the acceptance of the report because its late appearance gave too short a time for proper examination. Mr. Neff objected to the method recommended for measuring diameters by a ball-ended micrometer, which he said was not a method of measuring but only of comparing screws. He called attention to the Brown & Sharpe screw-thread micrometer, which he considered much better and with which the committee did not seem to be acquainted. Mr. Burlingame considered the 1/8 flat at the top and bottom of the thread too little for small sizes, as it did not give sufficient allowance for wear in the tap teeth. The practice of the Brown & Sharpe Company is to make the flats for these small sizes 1-6 the pitch. He did not consider the range of diameters sufficient, as the Brown & Sharpe Company had found it necessary to use threads finer than the Sellers standard up to 1 inch diameter. He noted the irregular intervals of the table and assumed them to be due to the necessity for using trade sizes of stock. He also criticized the diameters of the heads, and with Mr. Neff urged that the report be carried over to the spring meeting. Mr. Upp criticized the angle of the head for flat-head screws, which he urged should be 80 instead of 82 degrees, and Professor Goss criticized the width of the slot.

In closing the discussion for the committee Mr. Bond pointed out that the report referred only to screws made from drawn stock with upset heads.

On motion the report was laid over until the spring meeting.

The meeting then proceeded to the reading of papers, the first being

Natural Gas under Steam Boilers.

By Jay M. Whitham.

The writer of this paper was recently called upon to give an opinion regarding the commercial operation of a particular mill, both with natural gas and with coal, at a certain price. No detailed data of any special or determinative value could be found in available handbooks and other publications, and this paper has been pre-

pared to put on record the results of the author's investigations, so as to aid engineers in reaching a fair conclusion on the problem from a commercial standpoint.

The paper opens with a statement of the value of natural gas products, the following table of the value of the annual production, which will come as a surprise to those who imagine that the palmy days of natural gas are over, being given:

$18,792,725 in 1890	$15,296,813 in 1898
15,500,084 in 1891	20,074,873 in 1899
14,800,714 in 1892	23,698,674 in 1900
14,343,250 in 1893	27,066,077 in 1901
13,954,400 in 1894	30,867,863 in 1902
13,006,650 in 1895	35,815,360 in 1903
13,002,512 in 1896	38,496,760 in 1904
13,826,422 in 1897	

Several analyses and tests of the thermal value of natural gas made by the writer are given, following which is a description of the method used in testing the gas meters used.

Preliminary tests were made to determine the value of white- and blue-flame burners, all of which agreed in showing that, in capacity, the advantage lies with the white flame, while in economy the results varied in the different tests. As a result of these tests the white flame was used in the boiler tests.

The boiler tests include a battery of six 250 horse-power Cook, a 200 horse-power Heine, and a 302 horse-power Cahall boiler.

The tests show that it is not possible to get better efficiency with natural gas than with coal, and prove rather that the best coal efficiencies cannot be obtained with gas. That is due to the large volume of "air for dilution" which must be supplied with gas burners. On the Cook boiler test, No. 799, the Orsat showed:

7.8 per cent. of CO_2.
8.05 per cent. of oxygen.
0.00 per cent. of CO.
84.15 per cent. of nitrogen.

100.00 per cent. total.

for the composition of the products of combustion at the boiler damper when 72.7 per cent. of the heating value of the gas was absorbed by the boilers for evaporation.

Such a poor analysis is almost an impossibility with any boiler when burning coal.

To produce a boiler horse-power

$$966 \times 34.5 = 33,327 \text{ B. t. u.}$$

must be absorbed by the water in the boiler. Assume that, on an average, natural gas has 1,100 B. t. u. per cubic foot. Then, if the gas is burned at 100 per cent. efficiency,

$$33,327 \div 1,000 = 30.3 \text{ cubic feet}$$

of gas must be used per horse-power per hour. Yet tests are sometimes reported where from only 17.4 to 19.8 cubic feet were used per hour per boiler horse-power.

Assuming 75 per cent. to be the best efficiency obtainable with natural gas under boilers (and this is very difficult), then

$$30.3 \div 0.75 = 40.4 \text{ cubic feet.}$$

of gas, at normal barometer and temperatures, which must be used per hour per boiler horse-power.

The author's conclusions are

(1) There is but little advantage possessed by one burner over another.

(2) As good economy is made with a blue as with a white or straw flame, and no better.

(3) Greater capacity may be made with a straw-white than with a blue flame.

(4) An efficiency as high as from 72 to 75 per cent. in the use of gas is seldom obtained under the most expert conditions.

(5) The "air for dilution" is greater with gas than with coal, so that possible coal efficiencies are impossible with gas.

(6) Don't expect, in *good commercial* practice to get a boiler horse-power on less than from 43 to 45 cubic feet of natural gas, the same being referred to 60 degrees Fahr. and 4 ounces pressure above a barometer of 29.92 inches.

(7) *Fuel* costs are the same under best conditions with natural gas at 10 cents per 1,000 cubic feet and semi-bituminous coal at $2.87 per 2,240 pounds.

This is based on 3.5 pounds of wet coal being used per boiler horse-power per hour, or 45 cubic feet of natural gas.

(8) Expressed otherwise, a long ton of semi-bituminous coal is the equivalent of 28,700 cubic feet of natural gas; while a short ton of such coal is the commercial equivalent of 25,625 cubic feet.

(9) As compared with hand firing with coal in a plant of 1,500 boiler horse-power output, coal being $2 per 2,240 pounds—considering labor-saving by the use of gas—natural gas should sell for about 10 cents per 1,000 cubic feet.

In the discussion Mr. Bailey and Mr. Hitchcock presented additional tests of their own. The latter controverted the author's conclusion that the efficiency is lower with gas than with coal. Mr. Brown made some corrections in the test reported as his, and agreed with Mr. Hitchcock regarding the comparative efficiency of coal- and gas-fired boilers. He regarded the blue flame as superior in both capacity and economy. Mr. Wellman gave the results of tests of his which gave gas at 10.2 cents as equal to coal at $1.55, plus the cost of handling coal and ashes. Professor Kent regarded the author's statement regarding "poor analysis" of the products of combustion to be ambiguous, but the author's conclusions regarding blue and white flames to be correct. Prof. Goss referred to experiments to determine the comparative value of gas and coal for domestic uses which give much higher values to the gas than steam boiler tests, due to the high efficiency of domestic gas stoves and the low efficiency of domestic coal stoves.

WEDNESDAY AFTERNOON.

From the "Amerika" the members and guests, to the number of something over nine hundred, walked to the nearby terminal of the Lackawanna Railroad, where a special train was in readiness to take them to the works of Henry R. Worthington, at Harrison, N. J., a suburb of Newark.

It was at first expected that about three or four hundred people would go to see these works; later, and at rather short notice, those who were to entertain these people were informed that there might be six hundred people. There were actually something over nine hundred, and, naturally, this great number over-strained somewhat the arrangements that had been made for their entertainment. Nevertheless, the affair passed off as pleasantly and profitably as could have been expected. Not more than half the people there could get on to a stand which had been prepared for photographing them. There was difficulty in getting luncheon, and still greater difficulty perhaps in hearing the address of welcome, delivered by Mr. Schwanhausser on behalf of the company, but the works are of tremendous size, and, of course, there was no over-crowding when the guests once reached the spacious floors of the various buildings.

THE NEW HENRY R. WORTHINGTON HYDRAULIC WORKS.

In addition to being the largest works for manufacturing pumping machinery in the world, the new works embody so many novel features as to warrant extended description.

The plan herewith shows the arrangement of the various buildings, which cover 40 acres and contain 750,000 square feet of floor space and two acres of skylight, and required in their construction 7,000 tons of structural steel, 11,000,000 brick, 3,500,000 feet of lumber and 24,000 cubic yards of cement.

The works are served by two railroad systems, having five miles of track, so traversing the property as to facilitate the direct progress of material from the foundries to the succeeding departments and to remove the finished product with the least possible handling. For the shifting of material in the yards, a 15-ton motive crane and 5-ton jib crane are used.

The entire works are electrically equipped, requiring 11,000 feet of lead cable, 66,900 feet of fire- and weather-proof cable, and 160,000 feet of similar wire for the light and power equipment, 20,000 feet of trolley wire for the cranes, 900 arc and 1,500 incandescent lights.

For fire protection 9,500 automatic

sprinklers are installed, which are supplied through 15½ miles of pipe.

The general water supply required 4 miles of pipe; the sewerage 2½ miles, and the heating system 40 miles.

The main foundry is equipped for large work, with loam pits, core ovens and core-rooms. The crane equipment consists of four electric 30-ton traveling cranes and five 15-ton jib cranes in the main bay. Side bays are swept by four 5-ton electric traveling cranes. There are two 84-inch cupolas having a capacity of 36 tons per hour, 75 horse-power electric-driven rotary blowers furnish the blast.

The molding-machine foundry is arranged to give as nearly continuous molding as possible, and four to five times the production possible with the same floor space as ordinarily arranged. The floor space is much reduced by the use of a grated flooring over the entire building over which flasks are dumped into the basement. Each machine has an independent bucket conveyor and electrically operated traveling crane with runway the full width of the building. The melting equipment consists of two 80-inch cupolas with a capacity of 30 tons per hour.

In the brass foundry, five Schwartz furnaces are used, each furnace having its own blower and motor. The center bay contains one 2-ton traveling crane operated by compressed air. The side bays are equipped with trolley hoists. Molding machines are employed in this foundry as well.

The chipping and cleaning room, extending across the end of these buildings, is accessible to all and is fitted with a 5-ton electric crane. Aside from the rattlers and sand blasts placed therein, there are two annealing furnaces of 12 tons capacity each. An additional chipping and cleaning room 100 ft. long is provided at the end of the main foundry. Here, as well, the system of grated flooring is adopted, the sand and dirt being removed from the basement by means of a conveyor.

The main machine shop has a center bay 60 ft. and side bays 31 ft. each in width. In the latter are two galleries, the second floor forming a gallery, running the entire length of the building. The center bay is spanned by three electric traveling cranes of 30, 20 and 15 tons, respectively, while the side bays are provided with twelve 5-ton cranes traveling the entire length. There are five hydraulic elevators of 5 tons capacity each. Numerous electric jib cranes are installed for serving the tools. All of the machines on the main floor are provided with individual motor drive. Group drives are employed in the galleries and for automatic machinery.

There are two erecting shops, one running parallel to the machine shop, the other at right angles, connecting the machine and low erecting shop. Both are equipped with ample crane facilities, the low erecting shop gallery serving for finished storerooms. The high erecting shop is spanned by a 30-ton electric crane, and has three galleries on each side which are equipped with electric elevators.

The testing and shipping shop is equipped with ten electric traveling cranes. One-half of this building is used for testing, having tanks located under the floor, and special testing stands with permanent piping arrangement for stock sizes of pumps.

The power plant is equally divided between boiler- and engine-rooms. There are nine Babcock & Wilcox boilers of 330 horse-power each, connected to one stack 200 feet high and 9 feet internal diameter.

There are two 750 horse-power horizontal cross-compound condensing engines of the Corliss type, each direct connected to a 500-kilowatt 3-phase generator. A third unit is now being installed.

The equipment also includes the following, of Worthington manufacture: Service pumps, air compressors, elevator pumps, vacuum pumps, feed pumps, centrifugal circulating pumps and feed-water heaters, and special surface condensers, used either on the condensing or heating systems.

Special Worthington cooling towers designed for 2,500 horse-power are also installed, arranged either for natural or forced draft.

The pattern shop and office building is devoted to the making and storing of patterns, except for a length of 100 ft., the first two stories of which are used for general offices, the third story as a restaurant, and the fourth as a drawing-room.

An air-lift system delivers 1,350 gallons of water per minute from four 8-inch driven wells to a reservoir having a capacity of 1,000,000 gallons. The water required for drinking and for lavatories is pumped direct to the 100,000-gallon water tower which supplies the automatic sprinkler service. In addition to the latter, fire protection is secured through a Works Fire Department equipped with two 1,500-gallon fire pumps.

A Loomis-Pettibone gas plant of 2,000 horse-power has lately been installed. Gas is used in the blacksmith, in the Schwartz furnaces in the brass foundry, the annealing ovens in the cleaning room and in all of the core ovens of the foundries.

The visiting engineers found these works particularly well equipped with the most modern ideas in special machinery, a very large use of milling cutters being made, particularly in such sizes of steam pumps as are made in large lots. Many of the special tools and fixtures used in the manufacture of water meters were also highly interesting and efficient.

A special train leaving the works at 4.45 P. M. conveyed the visitors back to the city, and in the evening they had the pleasure of listening to the address of Professor R. W. Wood, of Johns Hopkins University, Baltimore, on the

PHOTOGRAPHY OF INVISIBLE PHENOMENA.

The lecture proved highly interesting and instructive. So far as that part of it was concerned which related strictly to the title of the lecture, it was not new to those especially interested in such matters, though Professor Wood's explanations and comments upon the phenomena shown by the pictures thrown upon a screen were highly enlightening and entertaining. He showed photographs of the waves set up in the air by the passage of a rifle bullet, and also the action which takes place when a rifle bullet is fired through a piece of plate glass. Incidentally he threw upon the screen a picture and gave an explanation quite clear to engineers of how and why it is that a cat held by the feet and dropped to the floor can always alight upon its feet.

Of especial interest was that part of the lecture which described the speaker's own experience with taking what he called "fish-eye views" by photography. These views are taken by a camera lens so shaped as to receive light coming to it through an angle of about 180 degrees, so that objects near the horizon are taken by it. The lens is pointed directly upward, and the result is a view believed to be similar, or perhaps identical, with that which is received by a fish swimming under the water; experiments having shown, however, that the human eye does not obtain such a view, or in fact any clear view of any kind when immersed under water, because the water causes it to be very seriously out of focus. The views shown were very curious and interesting, and with the others evoked round after round of appreciative and well deserved applause.

At the close of the lecture, refreshments were served in the room below, incident to which was the usual good time for everybody.

During this and the preceding evening, at one corner of the beautiful auditorium, there had been an electrically illuminated and beautifully colored monogram sign containing the letters, A. S. M. E. This had been designed and constructed by members of the society connected with the Edison Company, and during an interval in Professor Wood's lecture, Secretary Hutton announced that this monogram had been presented to the society by the engineers referred to, and that it would be taken to the new engineering building. It constituted, he thought, an example of the highest art of electric sign maker, and certainly it was apparent that the audience enthusiastically agreed with his estimate of the value of the beautiful monogram, which is about 5x6 feet, each letter being in a different color, so that all are distinctly brought out, and the effect is remarkably beautiful and in most excellent good taste.

THE SESSION OF THURSDAY MORNING.

The meeting was called to order at 10.30 A. M., and the Topical Discussion on Bearings was immediately taken up; some of the discussions which had been received in time to be printed being first read in abstract by Secretary Hutton.

The first one read was on Locomotive Bearings, by Geo. R. Henderson, New York city. In this paper the limitations to the size of bearings which are met with in locomotive practice are mentioned. Reference is also made to the practice of trying to obtain additional length to a bearing by adding on to the length at one side, thereby making a bearing in which the center of pressure is not at the center of the bearing; such a result not being satisfactory on account of heating and uneven wear. An illustration of this practice is given and analyzed, and the paper closes with the following remarks:

"Of course, we do not mean to indicate that ordinarily an engineer would wantonly place a load eccentrically on a bearing, but under the conditions quoted it is often difficult to reduce the unit load to the desired value, especially as it is a serious proceeding to increase the diameter of the axle over what is actually needed, and, besides, an increase in diameter augments the rubbing speed and ordinarily overcomes the benefit of reduced pressure, except as to forcing out the lubricant. As outlined above, however, it is generally preferable to get along with an increased unit pressure, rather than to create an eccentric loading."

Next, a report of tests made for the committee by Professor Carpenter was briefly referred to, and then the printed discussion by Albert Kingsbury, of East Pittsburg, Pa., was rapidly gone over by the secretary. This paper is a quite detailed report of tests made in 1904 by the Westinghouse Electric & Manufacturing Company at its East Pittsburg works, of some shafts of sizes 15x40 inches and 9x30 inches; the experiments being undertaken for the Niagara Falls Hydraulic Power & Manufacturing Company, for whom the special apparatus described was made. The paper contains photographs, drawings, and plotted curves regarding the results of the tests, also a table giving very fully all particulars of loads, pressures, speeds, horse-powers, coefficients of friction, temperatures of cooling water, and of bearings and comparison of tests made with heavy machine oil and with paraffin oil. The thickness of the oil films is also given for the various cases. The paper states: "As will be seen from the table of data and results from the tests, it was found possible to run the bearings with loads and speeds greatly exceeding the ordinary values in practice, even without water-cooling the bearing sleeve. The extreme case of a successful test is shown in column 12, in which a run was made under 94,000 pounds' load at 1,243 revolutions per minute with only a very small amount of water run through the bearing sleeve, merely for determining its temperature. The oil supply, however, was cooled in all the tests except No. 7, and the first half of No. 13. It may be noted in the table that the power required to drive the shaft was very nearly proportional to the speed of rotation, independently of all other conditions, such as load, final temperature attained and lubricant used. This result is probably not a general law, but is noteworthy even as an accidental relation."

After this a short discussion by C. W. Naylor, Chicago, Ill., was read in abstract. This described a remarkable substitution of a very cheap lubricant, namely, Lake Michigan hydrant water, for oil, in a certain case of two jackshafts 5 inches in diameter, running 250 revolutions per minute. These shafts had been for two years lubricated with oil and different greases and had given very much trouble, so finally water was tried, and for a period of eleven years they were run with water alone, oil being fed in only at the time of closing down in order to prevent the shaft rusting and sticking over night. The results were quite satisfactory.

Next was read a written discussion by G. W. Dickie, San Francisco, Cal., who had responded to the request of the committee for a statement of the case from the aspects of marine engineering. Among other things he referred to the thrust on a shaft resulting from the use of a Parsons turbine, which for this reason was an ideal form of motor for a ship, because this thrust balances the thrust of the screw propeller and renders thrust bearings unnecessary.

A written discussion by Jos. J. White, New Lisbon, N. J., described a journal box designed to overcome the difficulty of adjusting the cap of the box in general use. It was to replace some bearings used in wood-working machinery for shafts making from 4,000 to 5,000 revolutions per minute. The original bearings had paper or wood liners to support the cap, held in place by four bolts, and the only way to determine whether the bolts were stopped at the proper point was to start up the machine and note how the bearings ran, continuing this process of adjustment and trial until the shafts ran without heat or vibration. The journal box which he illustrated was patented by him in 1891, and was made with a cap fitting accurately between the side walls, where it was clamped by bolts running across above the journal.

The secretary then read a written discussion by Geo. M. Basford, New York city, discussing the subject of bearings from the standpoint of locomotive design. The paper states that the unknown quantities in the matter of stresses to which locomotive parts are subjected place locomotive design in a class by itself. In the matter of locomotive bearings, it is of little practical use to study the coefficient of friction. Rules for bearing pressures, which are entirely satisfactory for other construction, will not answer at all for locomotives. Bearing areas for locomotive journals are determined chiefly by the possibilities of lubrication. They are affected by the very severe service to which locomotives are subject, and the presence of dust, sand, ashes and cinders must be reckoned with. Concerning locomotive bearings, experience has shown that crank-pins may be loaded to from 1,500 to 1,700 pounds per square inch. These bearings are subject to alternating stresses, rendering lubrication relatively easy, and lubrication is really the limiting factor in locomotive bearings. Wrist-pins may be loaded to about 4,000 pounds per square inch, because their rotary motion is not complete, and the thrust changes twice in every revolution.

With journals the case is different. For locomotive driving journals it has been found that the following figures give good service:

Passenger locomotives, about 190 pounds per square inch; freight locomotives, 200 pounds per square inch; switching locomotives, 220 pounds per square inch.

Car and tender journals present the condition of beams fixed at one end and loaded more or less uniformly. In these cases, two limitations to the size of the bearings are presented:

1. The fiber stresses of the journal must not be too high.

2. There must be sufficient bearing area to insure cool running.

As a rule, the various sizes of axles adopted as standard by the Master Car Builders' Association may be loaded slightly more in pounds per square inch of projected bearing area without exceeding the allowable fiber stress, than would be permissible to provide properly against heating; but both of these limitations must be borne in mind.

Car and tender bearings are usually loaded from 300 to 325 pounds per square inch of projected area, but even this unit load is misleading, because in parts the load per square inch of actual bearing area may be very much higher because of the rough character of the bearing.

Next came a paper from P. H. Been, Milwaukee, Wis., the author of which, as Mr. Hutton remarked, had evidently taken the committee's list of subject heads and answered them right through. This paper describes the practice of one of the largest Corliss engine builders in the United States, as used for engines which are either belted for power purposes or direct-connected to generators.

1. Metals suitable for bearings.—All bearings are babbitted. The method of putting in the babbitt is described, but the composition is not stated.

2. Lubrication of bearings.—Pressure

oil cups are superseding the oil box on bearings. On a few engines, oil has been fed under the shaft by pressure; but this, however, is not the customary way of oiling bearings. The standard method is to place the oil cup on the cap of the bearing, and the oil drops from the cup into a cored pocket in the top shell, this pocket being filled with waste. Most engineers flood their bearings with a mineral oil, using the same over again by a gravity oiling system, the amount of oil used depending upon conditions.

3. Method of cooling bearings.—Bearings of standard construction have no means of being cooled. In special cases the lower shell is cored, so that water can be run through it, though in most cases this has been found unnecessary.

4. Limit of speeds and pressures.—The greatest pressure per square inch of projected area allowed for all shafts is 140 pounds. The speeds of these shafts run between 75 and 150 revolutions per minute. On most engines we find that the pressure per square inch, multiplied by the circumference of the shaft in feet, multiplied by the revolutions per second, lies between 1,000 and 1,300.

5. Design of bearings for high speeds and high pressures.—Bearings for horizontal engines are generally made in four parts—one bottom, two side, and one top box. Bearings for vertical engines are in two parts—one lower and one upper box. The provisions for adjustment and taking up wear are described.

6. Thickness of oil films, or allowance between journal and bearings.—There is no information about this for Corliss engine bearings to the knowledge of the author.

7. Thrust bearings.—Not used for Corliss engines.

8. Ball bearings.—Not used for Corliss engines.

9. Roller bearings.—Not used for Corliss engines.

The next discussion read was one by Asa M. Mattice, Milwaukee, Wis., which treated principally of lubrication. After this, a written discussion by Frank Mossberg, Attleboro, Mass., was read. This described the Mossberg roller bearings, made by the Standard Machinery Company, Providence, R. I. This company manufactures two distinct types; namely, the cylindrical form, which is used on revolving shafts and journals to carry a radial thrust. The second form is known as an end-thrust bearing.

The underlying principle of the cylindrical form is that of distributing the load on as many rollers as possible, and with this in view the rollers are made small in diameter. It is assumed that the rollers interposed between journal and box surfaces form only line contacts, and consequently a small roller will carry as heavy a load as a large one. A table is given, stating diameter of rollers, number of rollers, and safe loads on journals, for journals from 2 to 24 inches in diameter, having a surface speed up to 25 feet per minute, and a length of journal equal to 1½ diameters. The number of rollers range from twenty to thirty-eight. The projected area of the journal is carried on about seven rollers, and in larger bearings on more. In rolling-mill practice the surface speed of journals is somewhat less; but the load very largely exceeds the figures given, in some instances being as high as 10,000 pounds per square inch of projected area of journal. Illustrations were presented, showing the kind of cage used.

As to material, they use rollers made of tool steel, not too high in carbon and not of too high a temper, an ordinary spring temper being best. Care should be taken that the journal or shaft is not made above a medium spring temper. The box, however, should be made from high carbon steel and tempered as hard as possible.

The cages are made from a good, tough bronze metal, and great care is taken to have the grooves for the rollers parallel with the axis of rotation.

The second form, or thrust bearing, is intended to take thrusts on a rotating shaft, such as a propeller shaft, worm shaft or vertical turbine shaft. It is formed with conical rollers, the apices of the cones meeting in the center, the angles of the cones being not over 6 to 7 degrees. If the angles were larger the outward thrust in a radial direction will be excessive and cause destruction of the outer ends of the rollers. Illustrations are given of these bearings, and a table given for shafts from 2 1-16 inches diameter to 9½ inches diameter, the outside diameter of the bearings, the number of rollers (30 to 32), the area of the plate upon which the rollers roll, and the safe pressure on the bearings for 50 revolutions and for 100 revolutions. For the smallest size bearings the pressures are 19,000 and 9,500 pounds, respectively; for the largest size, 9½ inches, they are 300,000 and 150,000 pounds.

As to coefficient of friction on these bearings, they have not very complete data, but some tests show that the coefficient for the cylindrical form of bearing is about 0.002, and for the end thrust the coefficient is about 0.0025.

During a period of about twelve years, about 300 rolling mills have been equipped with Mossberg bearings. The cost of maintenance is no more than with ordinary sliding bearings, and the saving of power averages more than 50 per cent. over ordinary bearings. They have been made as large as 24 inches diameter, for paper calendars. The use of a poorly constructed roller bearing, such, for instance, as placing a number of rollers loosely around the journal, with merely clearance at each end to keep them in position, or a roller bearing with a flimsy cage which can easily become twisted out of shape, is bad practice, which has led to many serious breakdowns and consequent general condemnation of roller bearings in general, as an unreliable device to be avoided. On the contrary, they assert that a properly constructed and properly applied roller bearing is a most reliable device.

Charles R. Pratt, New York city, in a short paper referred to his article in the AMERICAN MACHINIST, page 705, Vol. 24, as an instance of a thrust bearing impossible to operate with friction washers, rings, balls, or cones. This article described a thrust bearing constructed of rolls ½ inch diameter by ¼ inch long (corners rounded to leave a tread of 3-16 inch) which gave perfect results where the other known types of thrust bearings failed utterly.

The construction and duty of this bearing were as follows: Rolls ½ inch diameter by ¼ inch long; 180 rolls arranged in two spirals, held in slots in a bronze cage; thrust plates 11 inches diameter by 1 inch thick, tool steel and pot hardened; speed, 300 revolutions per minute; thrust load, 20,000 to 80,000 pounds; load per roll, 111 to 444 pounds; rolls rotated in circles of from 4 to 10 inches diameter. He had found the limit of work for ½-inch balls in thrust bearings to be 100 pounds load per ball at 700 revolutions per minute and 6 inches diameter circle of rotation. Roller bearings at this duty are apt to be noisy.

The next written discussion was by Samuel S. Eveland, Philadelphia, Pa. This was a long paper on ball and roller bearings. The rapid growth of the industry of making such bearings is referred to, from 100 men engaged upon it in 1898, to 1,500 at the present time; but the business is still, however, in its infancy, and he stated that "nothing has been developed that will enable a mechanical engineer to design a satisfactory anti-friction bearing. The only reliable data on the subject have been secured by the manufacturers in actual practice, and they will supply designs for bearings that will give satisfaction under specifications submitted."

He spoke of the necessity for making all the parts of the bearings true, and stated that whether it is two-, three- or four-point contact is of minor consideration.

Results of some comparative tests made by the United States government on bearings for a revolving lighthouse lens are given; one bearing being made with commercial balls true to .001 to .002 inch, while in the other the variation was limited to .0001 inch. The great saving in power required to revolve the lens, when the special accurate ball bearing was used, was shown. In one of the tests, the pressures required were 64 ounces, 3 ounces and ½ ounce, respectively, for the standard government ordinary bearings, for the special plates and government balls and for the special ball bearing complete.

It is stated that case-hardening steel gives satisfactory results for the plates, sleeves, cup and cones, for both ball and roller bearings. It is cheaper than tool steel, more easily worked, and less liable to have cracks or flaws. The prejudice which exists to some extent abroad against case-hardened steel is because they have not reached the high development of the art of hardening which has been reached in the United States. There seems to be a belief, even among engineers, that roller and ball bearings require no oiling. This is a mistake, as even if no oil were required as a lubricant, it is absolutely necessary in order to prevent rust due to moisture caused by condensation or other causes. Both roller and ball bearings, to give the best satisfaction, should be made of steel, hardened and ground, accurately fitted and in proper alinement with the shaft and load; cleaned and oiled regularly, fitted with as large size balls and rollers as possible, depending upon the revolutions per minute and load to be carried. If used as above recommended, they will return their cost many times over in power and oil saved, in a very short time.

Roller Bearings.—Roller bearings have some advantage in strength over ball bearings, but for high speed the latter are generally recomended. In using roller bearings, it is preferable to have the rolls of steel, hardened and ground, and to run them upon hardened and ground surfaces. The rolling action of the bearing, if run on gray iron, grinds the latter into powder; and if run on soft steel, it condenses the metal, causing the bearing to become loose. Probably a few examples of results obtained by the use of roller bearings would be more interesting than a theoretical dissertation upon their advantages. The saving in power varies, depending upon the conditions under which the bearings are used, and whether they were kept clean, oiled and in proper alinement. On electric automobiles, tests have shown that they run 20 to 25 per cent. farther on one battery charge than if plain bronze bearings were used. A number of tests of other bearings are given, including a series of severe tests on the largest antifriction bearing ever made, recently tested at Niagara Falls on a 5,500-horse-power unit, the rotary weight on the bearings under normal conditions being about 156,000, but under certain conditions increasing to 190,000 pounds. The normal speed is 250 revolutions per minute, but may reach double that number if control of the governor be lost. The roller thrust bearings ran perfectly in all the tests and showed no wear, and less than 10 per cent. of the oil formerly used with gray-iron thrust disks was consumed.

Steel Balls.—In making steel balls, no method has been described to finish them all through to size. For instance, in a lot of ¼-inch balls, some will measure exactly .250 inch; others one-quarter thousandth larger, or smaller, etc. In packing balls, all in each box are properly marked and of one size—0.250 inch all O. K. size in one box, the one-quarter thousandth large in another and one-quarter thousandth small in another, etc. This is not always understood, and a purchaser throws them all together, using them as required. As a consequence, balls may vary as much as .001 inch or more in one bearing, which is not necessary if the trade method of packing them is understood. The balls are graded, special balls or "high duty," "A," or first quality, "B," or second quality, and so on down to culls. "High duty," or special balls, vary not over one-ten-thousandth of an inch; "A" grade one-quarter thousandth; "B" grade about .001 inch or .002 inch.

The crushing strength of balls should rarely be given, as it is very misleading and has very little importance in considering the load a ball bearing will carry, as the revolutions per minute is quite as important as the load. An ordinary commercial ¼-inch ball will crush under about 6,000 to 6,500 pounds, and a ½-inch ball 25,000 to 35,000 pounds. But the speed of the balls is as great, or a greater factor in the endurance than the crushing strength just given.

Another point of importance in considering the crushing strength of a ball is the fact that the temper of the balls, in hardening at various heats, changes materially the weight it will carry. Some typewriter companies, for instance, use what is termed a "glass-hard" ball, which will stand less than 50 per cent. of the strain which an ordinary tempered ball will carry, and would crush instantly under even moderate shocks. They are so hard that they are literally "glass-hard." At the other extreme are balls drawn at tempers especially for use where there is extreme shock or strain. Where an ordinary ¼-inch ball would crush at 6,000 pounds, the "glass-hard" would do so at from 1,500 to 2,000 pounds, and the special temper at 10,000 to 12,000 pounds; yet the crushing strength they will withstand has no bearing upon the actual commercial load such a ball will carry. Therefore, great care should be exercised in designing bearings, to use the largest balls possible, and especially for high speed.

This concluded the reading of the written discussions at hand, and the chairman made the following remarks: "The wisdom of the Committee on Meetings in selecting so fruitful a topic for discussion is apparent. There is, however, one line of study in this matter which apparently has not been treated, and that is an investigation from the standpoint of the physicist, which I should be very glad to see taken up, and I would suggest the name of one gentleman who is very competent to do this, namely, Professor Slichter, of the University of Wisconsin."

W. S. Rogers, Bantam, Conn., discussed the matter of ball and roller bearings orally. He said that he was going to treat the subject from the practical engineer's standpoint, giving some results of his experience and tests of ball and roller bearings under various conditions in the past twenty years. He remarked that it should be understood that ball and roller bearings were not adapted to be used everywhere and under all conditions; that the old plain metallic bearings would remain years after we have passed away. He illustrated on the blackboard some tests which he had made years ago, and had recently repeated with the same results, being a comparative test of a roller bearing using ⅜-inch rollers and a car-brass on a 3-inch journal, the bearings having in each case connected to them a cord passing over a pulley, with a weight suspended to the other end, and being run at different speeds, the effects on the angular position of the bearings was noted. The sketches illustrated the positions of the bearings at 100, 300 and 450 revolutions per minute, at which latter speed the cord on the roller bearing wound up and broke.

Mr. Rogers stated that the correct proportion of a roller bearing was when the rollers were of the same diameter as the shaft, but if this practice were to be followed, for instance on railroad cars, you would have to cut away the right-of-way, and if followed on line shafts the men in the shops would have to work outdoors. Mr. Rogers' five minutes having expired, his time was extended. He remarked that, like Mark Twain, he would talk as long as there was anybody to talk to. He referred to the Sellers shaft hangers, and said that as long as we stick to this hanger we will never have anything satisfactory. At first bearing manufacturers tried to make their bearings to suit the Sellers hangers, with very inferior results.

He gave an instance of a water-wheel which he had seen which formerly required the full gate opening, namely 12 inches, to drive it, but now with a roller bearing (which has not yet been put on the market) the gate opening required was only 1½ inches. This is a good illustration of the saving in power effected by the use of the improved bearings. He gave the maximum load which should be put on a 1-inch ball at 1,000 pounds, and the maximum load for a ½-inch ball at 200 pounds, and cautioned against letting the balls become mixed in the boxes. Also, he spoke of the necessity for calipering every ball, for balls are seldom round but are more like hen's eggs. He gave a sketch of a roller bearing which he called "a cat with two tails" and described as the greatest fallacy on the market. It was a bearing in which the rollers were parallel to the axis of rotation, and the interior sleeve at one end was enlarged or provided with a collar against which one end of the roller pressed, and the exterior sleeve had a collar at the other end, against which the other end of the roller pressed; the object of this arrangement being to combine a thrust bear-

ing with the roller bearings. This arrangement was quite worthless; the bearing would be pinching at one end and at the other end the bearing would not perform its functions at all.

A discussion by Horace K. Jones, of New Britain, Conn., was next read by the secretary. It described experience with the lubrication of 3,000 feet of shafting in the Russell & Erwin plant of the Corbin Screw Corporation; the average diameter of the shafting being 2 7-16 inches and the speed 150 to 500 revolutions per minute. Every bearing of this shafting has a suction oiler in the center, and some have ring oilers also at each end. So far as they have been able to discover, the bearings with suction oilers alone are working equally well with those having both kinds. There is also in the plant about 4,000 feet of shafting and 1,300 separate machines which are oiled by hand.

West Virginia native oil was used for many years, giving good service; until, upon it becoming difficult to get this oil, they had to change, and used first a black oil, a by-product in the manufacture of kerosene, which was not so good. They then changed to "engine oil," the result being that the horse-power required to drive the shop, as compared with when they were using black oil, was reduced from 567 to 428, a saving of 24½ per cent.

In another factory, he saw the caps removed from a line of hangers which had both suction and ring oilers. The oil was very thick, and nearly every one of the ring oilers was stuck fast and inoperative, but every suction oiler was in operation and abundantly oiling the shafts. The speaker presented one of the suction oilers for examination. It was taken from a 2 7-16 inch hanger, which had no ring oilers, and which had been in use 29 years and 10 months, much of the time 12 to 14 hours per day, the shaft making 300 revolutions per minute, and it has worked perfectly all this time and there is a mathematical certainty, he declared, that under unchanging conditions it would do so for 1,000 years.

From experience with some generator bearings which had melted, he recommended that generator and motor bearings be fitted with suction oilers at the centers, in addition to the ring oilers at the ends.

Henry Hess, of Philadelphia, read his own paper, which he called a rather brief and cursory review of ball and roller bearings, the time not being sufficient for an analytical discussion. This paper stated that some years ago Professor Stribeck, head of the technical laboratory at Neu-Babelsberg, near Berlin, undertook for one of the leading industrial establishments of Germany a thorough investigation of the entire subject of the relation of sliding, roller and ball bearings. The maximum loads under which the temperatures remained constant were determined. There was also considered the time that a bearing had to be run under a given load until such constant temperature was attained. A diagram was exhibited, giving the relation of the coefficient of friction (referred to the shaft diameter) to the specific loads. For sliding bearings, the specific load is the pressure in kilograms per square centimeter of projected journal area; for roller bearings 1-5 of the number of rollers, multiplied by the length and diameter of the rollers, is considered as the equivalent of the projected journal area; for ball bearings, 1-5 the number of balls, multiplied by the square of the ball diameter, is considered as such equivalent. Within the limits of numbers of the balls and rollers in an ordinary bearing, 1-5 of such number may be considered as practically sustaining the load, though naturally not all to an equal extent. For roller and ball bearings, angular velocity has not much influence within quite wide limits, limits which are wider for balls than for rollers. If the balls or rollers were absolutely true, no lubrication would be necessary; but as they are not true, there must always be some sliding, so we must always have lubrication. This was a long paper, discussing at length the matter of ball and roller bearings; twelve examples were shown by blueprints, being taken from foreign practice, principally German, and including bearings for quite a variety of purposes. These drawings were very clear and were exceedingly interesting. Among the examples were included bearings for a cement mill, for a pillar crane carrying 39,000 pounds, ball bearings for crane hooks, bearings for railroad cars of the Prussian State railways, bearings for heavy automobile trucks, bearings for a gasolene engine for an automobile, with the main-shaft bearings and the crank-pin bearings made as ball bearings. Mr. Hess stated that this latter case, namely, the crankshaft bearings for gasolene engines, presents some of the most difficult conditions. There was also a very elaborate drawing showing a complete transmission gear for an automobile truck carrying about 20 tons load, which was equipped with ball bearings.

For line shafts employing soft rollers the journal length works out but slightly less than for the usual plain box. It is important that the rollers should be parallel to the shaft when under load. Tests of various cage constructions and of free rollers have shown that this is attained most nearly when the rollers are not tied together, but are left free to adjust themselves; lack of truth will cause a slewing of the rolls as they pass under the load; as they pass out to the free side of the journal they can again straighten out, unless confined in rigid relationship to those still under load.

An analysis is made of the reason why the ball bearings in the tests showed such a relatively high efficiency in carrying capacity as compared with the rollers; prominent among these reasons being the difficulty of making a roller bearing quite true.

It was found that the frictional resistance was least for balls rolling between straight-line sections.

Specialists in the manufacture of balls can deliver them at relatively small cost, the balls being true spheres to within less than one ten-thousandth of an inch. This fact suggested the substitution of a large number of balls for a small series of rollers, the solution arrived at by Simonds, of Fitchburg. A German engineer, Riebe, decided to overcome the lack of truth of the shaft and the box by using but a single row of balls, giving a journal of no appreciable length, that therefore could not cause trouble by deflection, and then to proportion the diameter and number of balls to the load to be carried.

That these two constructors have, backed by the researches of Professor Stribeck, been successful to the point where the most conservative need no longer shy at the employment of ball bearings under any conditions, is best proven by the consideration of a few typical examples from actual practice. The examples previously referred to were then described.

A word of caution is given: Far greater care is called for in the proper design of ball and roller bearings, as compared with plain bearings, since with the latter the consequences are confined to a rather more rapid wear than is desirable, while the heating may be counteracted by a liberal use of cooling agents and oils. With ball bearings, however, there is no such thing as wear, but rather an actual breaking up of the surfaces that spells rapid destruction, which cannot be resisted by oiling or cooling. Then, too, the workmanship as to truth of surface and uniformity in size of balls must be of a very high grade, and further, the composition of the material must be much more uniform than for other purposes in the mechanic arts. Finally, a definite knowledge of the capacities of the materials employed is essential. Given these essentials, great reliability, friction elimination and other advantages result. Lacking these, failure and disappointment may be looked for.

Mr. Johnston spoke on ball and roller bearings. He advised that it is not well to try to hold the balls too rigid. As a matter of history, the Old Colony Railroad, in 1881, equipped its Fall River train with roller bearings. These bearings had no cages; the balls, or rollers, ran in contact. He stated that he could never understand why cages should reduce friction between the balls. The pressure producing the friction in the ball or roller bearings was radial, so how could there be any pressure to produce friction between a cage and a ball? One of the most successful bearings he knew of had simply a rough cage, cast in the foundry. He gave a formula for carrying capacity of roller

bearings. Some manufacturers talk about projected area. In his formula, which he had used for many years, for slow-moving loads, he has 1,250 times the square root of the diameter, multiplied by the total length in inches, divided by 4. For heavier loads running at higher velocities he cuts the constant down, the constant being determined by experience.

Some time ago, one manufacturing company printed a statement of 20,000 pounds per square inch of projected area as used on hardened and ground rollers and races. Now, if they had only stated how many rollers and what were the diameters, we could then determine what constant could be inserted in the formula, and we would have a measure for comparing different roller bearings.

Oberlin Smith, Bridgeton, N. J., stated that the importance of having the bearings absolutely accurate has been exaggerated. His advice was to make the rollers as large as possible in diameter, and to make the bearings as long as possible. Mr. Smith compared the action of the surfaces of ball or roller bearings to the flattening out of a bicycle tire resting on the ground, stating that the portion of the ball in contact with the cone or race was slightly flattened, and also the surface of the race itself was slightly indented, so that there was no such thing as a line contact, all bearings having some width to them, though of course this might be very small. He spoke of the carelessness and cheapness of design of many of the ball bearings in the market, giving some experience on an automobile tour, in which a ball bearing costing one or two dollars gave out, and they had to walk home; when, if they had had bearings costing five dollars, they should have had no trouble. The cause of this was that the shell of the bearings was too thin, and the case-hardening had had a peening action on it and caused it to stretch so that it broke.

Mr. Smith referred to the service in power presses, in which the stresses were very severe, the amount of these stressss not being very well known. There is no rule as to maximum pressures. Ordinary bearings on a toggle press, made of hardened steel, 3 inches in diameter, 40 inches long, sustain 400 tons' pressure, and sometimes in case of an overload get much more. The projected area near the center (meaning by this the portions of the circumference the farthest removed from the center of pressure) does not amount to much in the way of helping in carrying the load. The pressure reaches 30,000 pounds per square inch. In this type of press, the pressure coming up from the bottom, causes the bearings to act like valves and grind themselves smooth, so that they work pretty well. The pins are of hardened and ground steel, and work with gun-iron toggles, or with hard phosphor bronze; steel castings don't work well because they are too much like the pin which works in them, and they cut.

He illustrated an eccentric strap, 24 inches projected area, which carries 84 tons' pressure, giving a pressure of 7,000 pounds, for constant work. He referred to the case of a fly-wheel weighing only about a ton running loose on the shaft, giving but a small pressure, perhaps 50 pounds per square inch of projected area, and yet it was necessary to bush this with bronze, the reason for this being that on account of the looseness of the fly-wheel on the shaft there was a wider line of contact, so that the 50-pound pressure gave more trouble than the 3,500-pound did on the same kind of bearing where there was a narrower contact.

F. W. Taylor spoke of some experience in a mill which had been designed to use 600 horse-power, but which was compelled to use from 1,400 to 1,700 horse-power, the shafting having been designed for the former low amount of power, and the driving belts speeded at 5,000 feet per minute, leading to very severe conditions for the shaft bearings. As a result, an investigation of the bearing question, obtaining the results of three years' experience, was made, and a formula for bearings was deduced, which Mr. Taylor did not have with him, but promised to add it to the record of his discussion. He stated that this formula, when used, was very satisfactory. He was at one time connected with a bicycle-ball factory, where many experiments were tried on various ball bearings, and where the best practice was thoroughly looked up. He had come to the conclusion that any data on ball bearings resulting from runs of less than three years' duration are apt to be very misleading. Any experiments of a few weeks' duration are not at all conclusive. In the best construction the bearings wear out through fatigue of the surfaces of the balls and of the bearings, and it takes them two to five years of use to show this fatigue. The surface of the ball flakes off in an almost invisible spot and continues until the bearings are obliged to go out of use.

H. G. Reist, Schenectady, N. Y., gave some figures as to the General Electric Company's practice in the matter of bearing pressures. The pressures on projected areas range from 30 to 80 pounds per square inch, the average being from 40 to 45 pounds. The lower pressure occurs in cases where the shaft has been enlarged to obtain sufficient stiffness. The higher pressures given are generally allowed only where the rubbing speed is small. The rubbing speed of the journals for ordinary machinery varies from about 40 feet to 1,200 feet per minute. The practice, as established by the General Electric Company, does not differ very much from an old formula which he understands was given by Professor Thurston many years ago, viz., the product of the pressure in pounds per square inch of projected area of the journal and the rubbing speed of the journal in feet per minute should not exceed 50,000.

The ratio of the length of bearing to the diameter generally used is 3 to 1, but in many places proportionally shorter length has been found preferable.

Oiling rings, usually placed not farther than 8 inches apart, have been generally used by this company with satisfactory results; a circulating system of oil to carry off the heat being used on bearings a foot or more in diameter.

The subject of step bearings is also treated, the lubrication of the step bearing used in the Curtis steam turbine being described and figures being given as examples of practice in these bearings.

As there was no more time to devote to this discussion, it was then suspended, the chairman making the remark that it would be well to hear from some experience with bearings which must be run without lubrication, such as those in very dusty places.

The following paper was then read in abstract:

Reinforced Concrete Applied to Modern Shop Construction.

By E. N. Hunting.

In this very valuable paper we have the main details of the design and the methods of construction of a reinforced concrete building built for a machine shop by the Taylor-Wilson Manufacturing Company, of McKees Rocks, Pa. The paper opens with two illustrations of a Pittsburg shop built in the most modern style of unfireproofed structural steel and equipped with modern fire apparatus, the pictures being taken before and after a fire which destroyed the building so completely as to be almost incredible, as it certainly is incomprehensible.

Following this comes the description of the concrete building, which is of a single story, 160 feet long by 102 feet wide, of the monitor roof construction, with side bays. The central bay carries a 30-ton traveling crane of 51 feet span, the girders which carry the crane being, like the rest of the building, of reinforced concrete. The girders are carried by columns spaced 20 feet apart. The roof over the central bay is a solid concrete arch 4 inches thick at the crown and 10 at the haunches. There are no skylights in this roof, the lighting being through two rows of large double sash in the sides of the monitor, with additional sash in the sides of the side bays and in the ends of the main bay —the elevations of the building being, in fact, chiefly windows.

The building is a noteworthy contribution to shop construction. The very limited fire-resisting properties which experience has several times shown to belong with the unprotected steel-frame building, will certainly cause many to look to concrete before adding to the number of buildings of that character now standing.

Moreover, with absolute fire protection the concrete building offers the further advantage of reduced cost. The author of the paper gives the cost of the building as 3¼ cents per cubic foot, and says that in some sections reinforced concrete can be built for almost the same figure as slow-burning construction, a statement which agrees with the estimates obtained by Mr. Bilgram, of Philadelphia, before erecting his concrete shop not long ago.

Mr. Hill read his discussion of this paper. He stated that he could hardly endorse the first eight paragraphs of the paper (which spoke highly of the adaptability, strength, fireproof quality, durability and economy of reinforced concrete construction). He expressed a desire to have more detailed figures with reference to the cost of construction. He spoke of his own preferences in the design of shop buildings, his idea being, instead of building expensive foundations, to make the buildings light and flexible, and to make no attempt to secure uniformity of settlement. He does not believe in reinforced concrete sidewalls 4 inches or more in thickness, considering that it is sufficient to use brick sidewalls, or concrete 2 inches thick on wire lathing, which makes a building light and flexible. He provides one skylight to each 400 square feet of surface, making no attempt to secure illumination from windows from the side, but getting splendid illumination from skylights, the windows being provided merely for ventilation. In order to reduce the glare of the sunlight through the skylights, he uses a fabric formed by spreading linseed oil on copper mosquito wire, the coating being 3-32 inch thick, and producing a yellowish light in the shop. It is true that this substance will burn, but some tests were made which showed that it was not as dangerous as might be expected. A lot of pine chips were placed on the skylight, and ignited; they blazed right up and it looked as if the whole skylight, wood frame and all, would be destroyed; however, the chips were removed and three minutes after, the flames had gone out; the wood frame of the skylight had not ignited, and the fabric had not burned beyond the point where the fire had been kindled.

Reinforced concrete is certainly durable. The first building he erected of it is now nine years old; this was erected in the middle of winter and some of it was at that time badly frozen, but the building is still in serviceable condition.

In reference to the question of durability Mr. Hill brought up an interesting question, viz., the amount of durability which is required. It is a question for the mechanical engineer to decide in any given case, how long *ought* the buildings to last? He referred to one plant which he had erected five years ago, which had developed so that now it ought to be torn down to make room for improvements. It is a great mistake, he thinks, to erect buildings at too great a cost, when there is often probability that at the end of, say fifteen years, they would have to be torn down to make way for improvements. The mechanical engineer should decide how long the building should last, and the constructing engineer will give him a building to last that period of time, but a lot of money should not be spent on a construction more durable than necessary.

He presented some photographs showing buildings which he had constructed, and in many of these the roofs were quite flat, no attempt having been made to carry off the rain-water, as he thinks there is no advantage in going to the expense to make the roofs shed the water. There is, however, an advantage in making them flat, inasmuch as they will then hold the snow, which serves as a heat insulator. It will become necessary, however, to make the *skylights* with sufficient slope to carry off the snow. On some buildings which he had erected he used a slope of 3 inches in 12, and the skylights were found to be tight; the slope, however, was not sufficient to prevent the snow from standing on them, and, as a result, 40 per cent. of the window space was dark until the snow melted. He also claimed for flat ceilings that the distribution of heat in the shop was more uniform, and there was no opportunity for the dust to lodge.

A written discussion by Joseph C. Schaeffler, Somerville, Mass., was then read. This gentleman stated that he considered Mr. Hunting's paper to be a very superficial description of the system of reinforced concrete patented by R. A. Cummings. Both the system described and that patented by Julius Kahn make use of diagonals, which theoretically make an excellent reinforcement for concrete beams, but practically speaking, the superiority of such construction over the beam reinforced with plain rods, which have been anchored by turning up the ends or in some other manner, is a matter of some doubt.

He thought the price of 3¼ cents per cubic foot was quite low, and inquired whether it included forms.

He took exception to Mr. Hunting's statement that the concrete mixture can be made with equally good results by very efficient mechanical devices or by the use of the most ignorant class of labor, as he considers the mechanical concrete mixer very much superior, both as regards final cost and quality of the concrete.

H. C. Turner, in a paper on reinforced concrete, gave some historical review of the use of this substance. He stated that concrete weathers better than most building stone, and is known to improve in strength and hardness with age. He cited some examples of concrete buildings containing heavy and rapid-running machinery, in which the vibration was almost entirely absorbed, among them being buildings containing printing presses, which he considers as severe a test for vibration as any which could be obtained. An account is given of a test made for the Department of Buildings in New York city on the resistance of building materials to the combined action of fire, water and load, copies of which report can be obtained from Professor Ira H. Woolson, of Columbia University. The fact that concrete can withstand very severe tests is sufficient proof that it may be conservatively adopted for factory buildings. The heat undoubtedly drives off some of the water of crystallization, thereby reducing the strength of the concrete on the face of the parts exposed to the heat. This loss of strength is very slow, and a heat of 1,700 degrees Fahr., kept up for four hours, will not penetrate the concrete more than about one inch. It is not reasonable to expect any such duration of heat in service conditions. The Baltimore fire demonstrated very clearly the fire resistance of concrete.

In New York and Brooklyn six-story factory buildings of reinforced concrete will not exceed the cost of mill buildings of brick and yellow pine more than 5 to 10 per cent., and under some conditions not as much as 5 per cent.

In concrete buildings, the construction is of equal if not greater importance than the design, and all work should be done under experienced and competent supervision. A list is given of ten concrete buildings under construction in New York city, ranging from four to eight stories in height.

The chairman remarked that "We have here a very fruitful topic, which might well serve as material for a future symposium; but, as one of the speakers said, we are just skimming the topic, and I hope it will be treated further."

Mr. Woolson gave an account of the test to which Mr. Turner referred, in which a building 18x12x14 feet, with a flat reinforced concrete roof, which had been loaded 150 pounds per square foot, was subjected to fire for four hours, and then cold water was played upon the roof, and subsequently the load was increased to 600 pounds per square foot, the amounts of deflection and condition of the structure being noted, the latter being very good.

Professor R. C. Carpenter, Ithaca, N. Y., said that it seemed to him that the cost given in the paper was utterly misleading and entirely erroneous; and that anybody who thinks they could come out like this would be disappointed. He made a brief analysis of the matter of cost, and gave figures from his own experience, referring particularly to the high cost of the forms and the matter of the proportion of the cement in the concrete. He had a very poor opinion of concrete as a material for roofs, and spoke of a building in which they had saved a great deal of money by using reinforced concrete up to the roof

only, and using an entirely different material for the roof. He stated that it was of course in the interest of the cement manufacturers to have as much concrete used as possible, but as a material for the roof it is bad; it has a high coefficient of expansion, and it is almost impossible to hold large masses of cement and keep it from cracking; and it is necessary to put up some other material to keep the water out and protect the machinery below. He considers reinforced concrete as very good for one story; above that point he uses concrete blocks, giving a building just as good, and which looks very much better.

F. W. Taylor expressed his appreciation of Mr. Hunting's paper, and he also wished for more detailed information regarding the matter of costs of material and labor.

Mr. Porter spoke of some common defects in the provision and construction of fire escapes; he spoke of the necessity that these devices should permit of a most rapid and unobstructed passage of the people in a building in case of fire or panic. One common defect was making the ladders between the galleries vertical, so that with a lot of people crowding down the escape, and especially in winter time when the iron is cold and perhaps covered with ice, accidents are very liable to result. He showed an illustration of a fire escape made in accordance with his ideas, the ladders being replaced by staircases, for which he recommended that the angle be 45 degrees or more.

Another disadvantage with the fire escapes as commonly constructed was illustrated by a common type, in which the distance from the first landing down to the ground was from 15 to 25 feet, and for this a ladder was provided which was kept hung up somewhere and had to be lifted off and put down; as this ladder weighs from 200 to 400 pounds, it would take three or four men to handle it, and in case of fire the men are probably not there, and the people are simply pushed off. He also objected to the construction which necessitates that persons should get down on their knees and go down backward. He gave examples of fire escapes which led down to very inconvenient places, such, for instance, as to an areaway behind a high iron fence, the gate of which was locked and the key kept in the building, also of a case where fire escapes were provided at the front of a building but the spaces on the different floors inside of the front wall were partitioned off for storerooms, rendering the fire escapes very inaccessible. His conclusion is that the only satisfactory way in most cases is to make sure that the fire-escape facilities are sufficient is to take a lot of people and go through an actual fire drill under conditions as much like those of an emergency as possible.

It having become quite late, the chairman under the rules called for the authors' closure of the discussion.

Mr. Hunting, answering Mr. Hill, promised to add more detailed information about cost to the published discussion, not having all the figures at hand. With reference to Mr. Schaeffler's exception regarding the comparative merits of hand and mechanical mixing, it had been his experience that concrete can be mixed by hand just as well as by machine, where the materials had received proper attention. In reference to Mr. Turner's discussion, which considered the construction as of more importance than the design, he differed from him inasmuch as he thought that the design was of equal importance with the construction. In answer to Prof. Carpenter, he took a firm stand regarding roof construction, Mr. Hunting's experience being that roofs can be constructed of concrete very successfully and that no better class of roofs can be made. He instanced as an example a roof constructed in Canada for the Canadian Westinghouse Company, 600 by 90 feet and 4½ inches thick. This roof has been very satisfactory. It is well provided with expansion joints, and is absolutely water tight. He sees no reason why a concrete roof of any size cannot be built successfully. As to the relative merits of reinforced concrete and concrete blocks, the former can be applied as a structural material to take the place of steel, while concrete blocks cannot. As to the proportion of the mixture, they never use anything under 1:2:4, and for columns 1:1½:3. The two barrels of cement per cubic yard, of which Prof. Carpenter spoke, was probably the cause of contraction cracks in the roof. A very rich concrete will show temperature cracks where a very lean concrete will not.

The chairman called attention to the size of the registration at this meeting, up to 11.45 A. M. on Thursday 1,260 having registered, 670 of whom were members, 370 guests, and 221 ladies. The session was then adjourned.

THURSDAY EVENING.

The social function, in the form of a reception and ball, which was given at Sherry's on Thursday evening, proved to be the usual enjoyable affair and was very largely attended. The Meetings Committee had introduced one new feature, which consisted of whistling solos, which were given during intermissions in the dancing by a young lady whose performance was certainly remarkably beautiful and seemed to be highly appreciated.

FRIDAY MORNING SESSION.

This session was held in the auditorium of the Edison Building, and was opened by the presentation by its author of a paper

ON THE MEASUREMENT OF AIR FLOWING INTO THE ATMOSPHERE THROUGH CIRCULAR ORIFICES IN THIN PLATES AND UNDER SMALL DIFFERENCES OF PRESSURE.

By R. J. Durley.

This paper describes some very complete and satisfactory experiments made under the author's supervision in the laboratories of the department of engineering of McGill University, Montreal.

In these experiments it was desired, first, to ascertain the laws governing the flow of air through circular orifices in thin plates at low heads; and, secondly, to measure the air discharged in such a manner that the experimental conditions could be easily duplicated at any time, so that a similar gaging apparatus might be used in the laboratory.

Circular orifices bored in thin plates were selected because of simplicity of formation, and it was found that with proper apparatus such orifices afforded a convenient means of gaging the amount of air discharged by fans, blowers, air engines, air compressors and the like.

The author first examines existing formulas for the flow of air, and then derives one of his own, which, however, in view of the small differences in pressure used in the experiments, he simplifies by omitting factors which are of small importance under these conditions. He then plots the two formulas, and finds that within the limits of the experiments their divergence is negligible, and hence adopts the simple form as sufficient for the purpose.

The experiments cover a range of orifices from 5-16 to 4½ inches in diameter, and a range of pressures from 1 to 5 inches of water. The experiments were obviously made with great care, and the results are extremely concordant and satisfactory. They furnish an accurate, excellent, inexpensive and hitherto unavailable means of measuring the discharge of fans, and one in which we should have greater confidence than in the anemometer. The author sums up his conclusions as follows:

(1) The coefficient for small orifices increases as the head increases, but at a lesser rate the larger the orifices, till for the 2-inch orifice it is almost constant. For orifices larger than 2 inches it decreases as the head increases, and at a greater rate the larger the orifice.

(2) The coefficient decreases as the diameter of the orifice increases and at a greater rate the higher the head.

(3) The coefficient does not change appreciably with temperature (between 40 and 100 degrees Fahr.).

(4) The coefficient (at heads under 6 inches) is not appreciably affected by the size of the box if the ratio of the areas of the box and orifice is at least 20:1.

The discussion was opened by Mr. Snow, who referred to the paper by Mr. Taylor before the Society of Naval Architects and Marine Engineers on Ventilating Fans, from which he gathered that the form and location of the U-tube used for measuring the pressure, was a matter of importance demanding fuller details than were given. He suggested the use of a series of 2-inch orifices, which should be closed by a gate in order to establish the

desired pressure behind them, instead of using orifices of varying size as proposed by the author, and he gave a modification of the author's formula suited to the use of such orifices.

Professor Kingsbury considered the experiments to be a distinct and valuable contribution to engineering literature. They will be of immediate use to himself in connection with experiments on fans which he has in contemplation. He referred to the disparity of opinion existing in connection with the Pitot tube, which is so great as to make its use impracticable. He closed by referring to the variation in the coefficient of discharge and asked the author if this might not be due to the fact that the orifices were in reality short tubes, and if this variation might not be reduced or overcome by beveling the edge of the orifice.

Mr. Supplee referred to the great simplification in hydraulic formulas, and the reduction of the variation in the coefficients by changing the form of the formulas, and asked the author if it were not possible that this process could be applied to his formula for the efflux of air.

The author in closing said that he had made many attempts to use the Pitot tube, but that the results were not encouraging. It was in fact due to such experiments that he was led to take up his present investigation. He had made many experiments regarding the location of the pressure tube employed, but had found very little effect to follow changes of this kind He considered Mr. Snow's suggestion that a series of 2-inch orifices be used to be good if the orifices were not located too close together. Replying to Professor Kingsbury, he agreed that his thin plates were in effect short tubes. He had tried the use of beveled edges, but had found the difficulty of manufacture with orifices of that kind to be so serious that he had given them up, although he thought their effect would be to reduce the variations in the coefficients. He regarded Mr. Supplee's suggestion regarding a change in the form of the formula as a valuable one.

Following this came a paper on

RESULTS OF THE PRELIMINARY PRODUCER GAS TESTS OF THE UNITED STATES GEOLOGICAL SURVEY COAL-TESTING PLANT AT ST. LOUIS.

By R. H. Fernald.

This paper opens by saying:

"An obviously necessary regulation of the Government prohibits the publication of results of the United States Geological Survey coal-testing plant until such results have appeared in official Government reports. This regulation is in a way unfortunate, as it prohibits the presentation at this meeting of the most reliable and most efficient results of the producer-gas tests. It not only necessitates confining the information and details to results already published by the United States Geological Survey, but forces the writer to confine his attention to preliminary work conducted under the erratic and often exasperating conditions of an exposition period.

"The operating conditions that are now maintained in the gas-producer division of the testing plant are so superior to those that were possible during the preliminary period that the results of the past several months show marked improvement over the figures here presented, but, owing to the Government restriction, they can be mentioned in a general way only at this time."

In arranging for the tests, no forms for log or report blanks could be found, and it became necessary to originate such blanks. These are included in the paper in order to bring out criticism, and thus aid in securing standard forms. It must be mentioned that these tests are producer-gas tests from a large series of coals—*i. e.*, the tests are for the purpose of determining the relative values of different bituminous coals and lignites as producer-gas developers, and they are not "gas-producer" tests, the object being to demonstrate the possibility of using these coals in a producer, and not to show how efficiently they could be burned. Although the results in many cases have been highly satisfactory, there is no question that in a second series of tests upon the same coals, made with the idea of showing the greatest economy, the amount of coal per horse-power per hour will, in the majority of cases, be much less.

Immediately after the close of the exposition, it having been decided to continue the tests for some weeks longer, the plant was shut down for repairs and to prepare for cold weather. Operations were resumed on December 12, and continued to December 22, when a holiday recess was taken. After the recess the tests were continued through the month of January. In all, twenty-four producer-gas tests were made during the period from the first of October to the first of February.

In beginning the new series of tests—May, 1905—a schedule was adopted involving two 60-hour tests per week. This was done to reduce possible errors in determining the amount of coal burned in the producer. The first 8 to 12 hours are now used for getting the fuel bed into a uniform and efficient condition. During this preliminary period records are taken as in the regular tests, but the official test includes only the last 48 or 50 hours of the run, during which time conditions are maintained as uniform as possible.

Although some of the coals used in these preliminary tests made excellent records, yet the results obtained since beginning the second series of tests in May, 1905, have been far more satisfactory, and it is gratifying to report that official records have been made as low as 0.95 pound of dry coal per hour burned in the producer per electrical horse-power developed at the switchboard; or 0.80 pound of dry coal per hour burned in the producer per brake horse-power per hour, on the basis of an efficiency of 85 per cent. for generator and belt.

Attention is also called to the fact that two tests upon the same coal, made on different dates and in the two different producers now in operation at the plant, gave results that checked beyond all expectations.

In the light of the information which has been obtained during the operation of this plant, together with the changes and improvements that will naturally be made in the construction and operation of producer plants for use in connection with bituminous coals and lignites, there is every reason to expect a development in this particular line which will make a marked increase in the efficiency of such installations.

In presenting this paper the author gave considerable information which was not contained in it, especially regarding simplifications of the producer plant used, which had been found to be practicable. Thus, finding the purifier to be ineffective in removing the sulphur, it had been discarded altogether, and although in some cases the percentage of sulphur was as high as 8 per cent. no harm had been done to the engine, although this percentage was far above the point at which the makers would guarantee the engines. The only precaution necessary had been found to be to keep the cylinders thoroughly dry, and with this precaution the engines had run repeatedly for an entire week at a time without being stopped. No effect had been found to attend the use of the economizer on either the composition of the gas or on the efficiency, and it had been discarded.

The discussion was opened by Mr. Younge, of the German Society of Engineers, who referred to investigations of this kind which had been carried on in Germany. In the course of these experiments modifications had been made in the producer by which the large amount of tar usually obtained was burned in the producer. He also referred to methods which had been devised for making producer gas from garbage, and he regarded this as the cleanest and most satisfactory method of garbage disposal. He referred to the large producer-engine plant of the Lackawanna Steel Company, and to the difficulties which had been found in its operation, together with the lack of faith in such engines by other steel manufacturers in this country. This lack of faith was due to the belief that the gas engine was not as reliable as the steam engine. As a matter of fact, the practice in Germany has developed to a point where these large engines consuming producer gas are as reliable as Corliss engines. He regarded the difficulty when

experienced as chargeable to the inefficiency of the cleaning arrangements of the producers.

The discussion was continued by Mr. Parker, of the United States Geological Survey, who referred to the author's statement regarding the discarding of the economizer, and said that it should be remembered that the producer had been made for use with anthracite coal, with which the economizer is necessary. Mr. Wyre referred to the author's statement that no precedents could be found for the blank forms to be used, and considered the time ripe for the society to take up this matter, and formulate a code after the manner of its steam-boiler and engine test codes. Secretary Hutton followed up this remark by saying that the forms used had been included in the paper in order to emphasize the necessity for such action, and to furnish a starting point for it. The society should undertake this work at an early date in order to insure that all tests should be in a form which would permit comparison. The society had done a distinct service in connection with its boiler- and engine-test codes, and he moved that the taking up of this matter through a committee be referred to the Council, and this resolution was carried.

The next paper was on

The Pressure Drop Through Poppet Valves.

By Charles E. Lucke.

Poppet valves are in wide use in gas engines, air compresors and steam engines, but their design heretofore has been simple empiricism, if indeed it is entitled to be called by even as dignified a name as that. To design such valves there should be available experimental data on the relation between pressure drop and the conditions tending to produce it, because it cannot be calculated on theoretic grounds, but on investigation it will be found that such information if unavailable.

The tests reported here had for their object the determination of some such experimental data on the relation between pressure drop through a poppet valve and the condition of flow, form of opening, etc., that give rise to the pressure drop observed. For any given velocity of flow the pressure drop will be greatest and most easily measured with a less dense fluid; for this reason atmospheric air was used. The gas engines in the experimental laboratories of Columbia University have poppet valves with flat and conical sets and are operated both automatically and by cams. These valves were so arranged for these tests as to allow measured quantities of air to flow both steadily and intermittently with various valve lifts and in both directions through the valves. The valve lift was measured by one special attachment for the tests made on the engines themselves and another the tests on the detached valves with steady flow. The air was measured by a large Westinghouse meter and all pressure drops were measured in inches of water on a manometer.

The experiments reported are very full and complete and supply all needed data for the rational design of poppet valves for air at atmospheric pressure. Valves under the condition of discharge valves in air compressors were not included in the experiments. The paper consists chiefly of tables and indicator cards, and is not capable of presentation in abstract.

The paper was read in abstract by Secretary Hutton, who said that the idea had been suggested to the author that he add certain conclusions and practical suggestions to the paper, and that this would be done. The discussion was highly complimentary to the paper. Mr. Hill pointed out that the experiments were made entirely with atmospheric air, whereas there is every reason to believe that the charge of a gas-engine cylinder behaves quite differently from air. He called attention to the importance of the forms of the cams used in gas engines, some of which would throw the valves and affect the results, and he was disposed to believe that some of the indicator cards showed such results.

The next paper to be taken up was on

Tests of an Elevator Plant in the Trinity Building, New York City.

By Arthur J. Herschmann.

The tests to which this paper relates are commercial tests made while the plant of the Trinity Building was in regular operation. It was not thought that the accuracy of the results would have been materially improved by resorting to greater elaboration in preparing for the test, or in the manner of conducting it. On the other hand, it was held that with the adopted plan data would be obtained which could be more readily compared with other buildings in regular operation and which should, on account of the peculiarity of elevator service in an office building, more correctly define actual economy than data which would result from a dead load test in which intermittency of service would not be portrayed.

Two series of tests are tabulated, the first referring to a duplex compound pump and the second to a high-duty fly-wheel pump, and numerous indicator cards are given from both pumps.

The machine tested was of the Plunger Elevator Company's make. The elevator tests proper were preceded by evaporation tests of the boilers. Each elevator test extended over nine hours, the number of passengers carried in one being 4,500 and in the other 5,000. The paper is mostly composed of tables, of which an abstract is scarcely possible, but it may be mentioned that the cost of the coal consumed per passenger was .24 cent with the compound and .13 cent with the fly-wheel pump.

The paper is accompanied by eleven large folded plates, and the connection of some of them with the object of the test is not apparent.

The discussion was opened by Mr. Bryan, who remarked that the tests show conclusively that the electric is far superior in economy to the hydraulic elevator. He, with others, thought the paper of a good deal of value. Mr. Pratt discussed at considerable length the claims made for the plunger elevator on the score of superior safety. J. E. Johnson, Jr., referred to the well known swaying of the plungers of these elevators as being very disquieting.

Mr. Bolton disagreed entirely from those who thought the paper of value, and could only account for these opinions by assuming that those who gave them had made very inadequate examinations of the paper. He answered Mr. Johnson's inquiry by explaining that the weight of the car is not carried by the plunger, but by the counterbalance ropes. He had found the paper so full of errors that no confidence could be placed in it; the results of the tests would not check up with one another in any particular. He did not regard it as a test at all, but as a mere series of observations on the everyday working of a plant. The tests of the boiler plant were very incomplete, but from his knowledge of the habits of firemen in office buildings he thought it very probable that considerable coal was unaccounted for in the test. He referred to the number of passengers carried, which was given as an even 5,000 in one test, and an even 4,500 in the other, and challenged the accuracy of these figures on the score of their improbability. He criticized the numerous inset sheets of engravings, some of which he said had no discoverable relation with the paper, and at least one of which was nothing but a reproduction of advertising literature. He challenged the claims made for the plunger elevator on the score of safety, and asserted that in this plant economy was being gained at the risk of the public. As a matter of fact one man had been killed by these elevators, under circumstances that were very suspicious. He pointed out that the elevators were being installed without safety appliances, because their construction is such that the laws relating to such appliances do not apply to them. Unlike other elevators, he said, the danger is upward and not downward. He closed by declaring the paper to be worthless.

Mr. Brown did not consider the swaying of the plunger to be an element of danger, although he said Professor Lanza holds a contrary opinion. He referred to Mr. Bolton's contention regarding the danger of the elevator shooting upward into the upper works in case the stop should fail to work, and said that this was

made impossible by the counterweight striking a buffer. Under these circumstances, the car if stopped at full sped, would rise only about 19 inches. He regarded Mr. Bolton's criticism of the test as unjust. He had found the elevator test to check up well, although he thought there must be an error in the boiler tests.

Mr. Matthews defended the elevator. The greater part of the plunger, he said, is carried by the car and the counterweight. The swaying is nothing more than the swinging pendulum.

In closing, Mr. Herschmann referred to the boiler tests as giving improbable results, but said they had been repeated and the results confirmed. The data of the tests were extremely voluminous, and a more imposing appearance could be given to the paper by presenting them, but he had limited the paper to results only. The number of people carried had been accurately determined by counters, and must be accepted. He failed to see the necessity for refined theoretical tests of elevators, and considered the results given as sufficient. In one case a lack of concordance among the figures was due to a typographical error. He denied the commercial character of the illustrations, and considered them pertinent to the paper. He denied an assertion made by Mr. Bolton that the boiler pressure had been raised to meet the guaranteed speed, and asserted that the loss of life was not chargeable to the elevator.

The session was closed by the presentation of

THE REALIZATION OF IDEALS IN INDUSTRIAL ENGINEERING.

By H. F. J. Porter.

This paper was published in full at page 760, and need not be repeated in abstract here. It was not read by Mr. Porter, but instead he gave a number of illustrations on the screen of social betterment features of various well-known shops and factories.

The discussion was opened by Mr. Calder, who referred to the experience of the Remington typewriter works. He considered the handling of internal features, which are apt to be technical, by a shop committee to be unsound, but that external features were best managed by such a committee. In their own works they have adopted service badges indicating that the wearers had been in continuous employment of the company for periods of 10, 15, 20 and 25 years, and which are much prized, especially as among the owners a bonus sum is periodically divided. They also use the suggestion box, and had provided baseball and cricket grounds which were managed by the workmen themselves.

Mr. Hawkins thought that efforts of this sort were efforts to save at the spigot while the bung was out, meaning by the bung the efforts of labor unions to restrict output; and he made a long and vigorous attack upon trade unions, which, however, was upon conventional lines, and said nothing that has not been said many times already. Mr. Beeman considered advancement from the shop force of importance—a demonstrator from the shop being, in his opinion, far more effective than a speed boss imported from without. The greatest success of these efforts has been in factories where the work is of a light character, and he thought they had almost entirely failed to reach men of mature years doing heavy manual labor. He had heard a most interesting lecture on the Klondyke arranged for employees of this class which was very slimly attended, and most of the audience asleep, although the lecture was extremely interesting. Pittsburg abounds in club-houses for employees, but they do not seem to reach men of this class, being monopolized by the young college graduates who are occupying subordinate positions in the works.

The meeting then closed with the reading by the president of a communication from the Machine Screw Threads Committee, asking for opinions and suggestions that would enable them to make a report that would be satisfactory.

The meeting was by far the largest on record, the registered attendance being 1,330, of which about 700 were members.

Planers Advanced in Price

In accordance with the movement which has now become somewhat general for an advance in the prices of machine tools, the Cincinnati Planer Company announces that a new price-list has been issued on its planers, in which prices are advanced from 5 to 10 per cent., with an average of about 7 per cent. for the entire line. This, we understand, is intended to partially cover increased cost, due to increased weight, increased cost of material and increased cost of labor.

Several recent cases of X-ray burns—if the destructive action of the X-ray on human tissue may be called a burn—direct renewed attention to the necessity of great caution in using this mysterious radiation, both on the part of the operator and patient. Just what is the chemical action of the ray on the tissue is not known, but experience shows that its effects may be very serious, causing deep "burns" which are very hard to heal. It is also alleged that the injury is apt to result in skin cancers, and at least one death is ascribed to the X-ray in this manner.—*Western Electrician.*

We have received from the Policy Holders' Protective Committee, 161 Devonshire street, Boston, Mass., a pamphlet containing an address by Louis E. Grandies, delivered before the Commercial Club of Boston, on "Life Insurance, the Abuses and the Remedies." The address contains a good deal of matter of great interest to all who now carry or may think of carrying life-insurance policies.

Frederick W. Taylor, President of the A. S. M. E.

The newly elected president of the American Society of Mechanical Engineers, Frederick Winslow Taylor, was born in Germantown, Pa., in 1856, and at the age of eighteen was prepared for Harvard College at Phillips Exeter Academy. At this time trouble with his eyes compelled him to give up study. He at once determined to get his education another way, and began to serve his apprenticeship as a patternmaker in a small steam-pump works in Philadelphia. In order to make as rapid progress as possible and to get some special advantages, he worked for less pay than the other apprentices, and in four years finished his apprenticeship, both as patternmaker and machinist.

When he came out of his apprenticeship in 1878, times were so dull that he could not get work at his trade, so he went to

FRED. W. TAYLOR.

work in the machine shop of the Midvale Steel Company as a laborer. Here he was promoted successively to the position of shop clerk, charge of the toolroom, gang boss, assistant foreman, and then foreman of the machine shop. Next he became master mechanic in charge of repairs and maintenance of the works, then chief draftsman, and, in 1884, chief engineer of the works—from laborer to chief engineer in six years.

Soon after he went to the Midvale Steel Works he began to feel the need of a more complete engineering education, and in 1880 began to study at night the engineering course of the Stevens Institute, in addition to his work of ten hours per day. He passed all his examinations and graduated as M. E. in 1883.

In 1890 he left the employ of the Midvale Steel Company, became general manager of the Manufacturing Investment Company to organize and manage some large chemical pulp mills, and after accom-

plishing this work devoted his entire time to the organization of various manufacturing establishments.

Mr. Taylor's most important engineering work consists in the design of a great part of the plant and machinery of the Midvale Steel Company, including the largest steam hammer running in this country. This hammer has been running steadily and with exceedingly small repairs since 1890, and for twelve years made all of the large gun forgings sold by Midvale to the Army, competing during this time successfully with the large and expensive foreign presses used by the Bethlehem company. This hammer was built on an entirely new and original design made and patented by him.

He has taken out between fifty and one hundred patents. His name is, however, chiefly identified with his system of management. He has endeavored to reduce shop management to an art, and his system of management is now successfully used in many establishments covering a large variety of work; the principal ones, however, being the Midvale and Bethlehem steel companies. In his development of management to a systematic art, he has made two improvements which are notable.

First, the discovery and formulating of laws for cutting metals with machine tools. The experiments leading to the determination of these laws lasted through a period of over twenty years and occupied much of the time of several other engineers who were assisting him in this work. He is now writing a book on this subject.

Second, the study of these laws led directly to the invention of the "Taylor-White" process of treating high-speed tool steel. This process and the tools treated by it are now used in almost every machine shop in this country, and also abroad, all the high speed steels, by all the makers, everywhere, being in all essentials, the same as first made by him and Mr. White.

Mr. Taylor's important papers written for the American Society of Mechanical Engineers are: "A Comparison of Various Fuel Gases," "Notes on Belting" (describing a practical experiment on the treatment and durability of all belts in a machine shop extending through a period of nine years), "A Piece Rate System," and "Shop Management." He also published this year, together with Sandford E. Thompson, a book of 500 pages on "Concrete, Plain and Reinforced."

He himself considers his most important achievement to be the winning of the first double championship of the United States in lawn tennis at Newport, though of course most of those who know of his work and accomplishments will not agree with him on that point. He is also an enthusiastic golfer, and whether he works or plays does it with all his might, and with an apparently inexhaustible supply of nervous energy. In everything he does he introduces new ideas and his residence at Chestnut Hill, Philadelphia, designed and built under his direction, is replete with features of beauty and comfort not to be found in any other, because original with its owner.

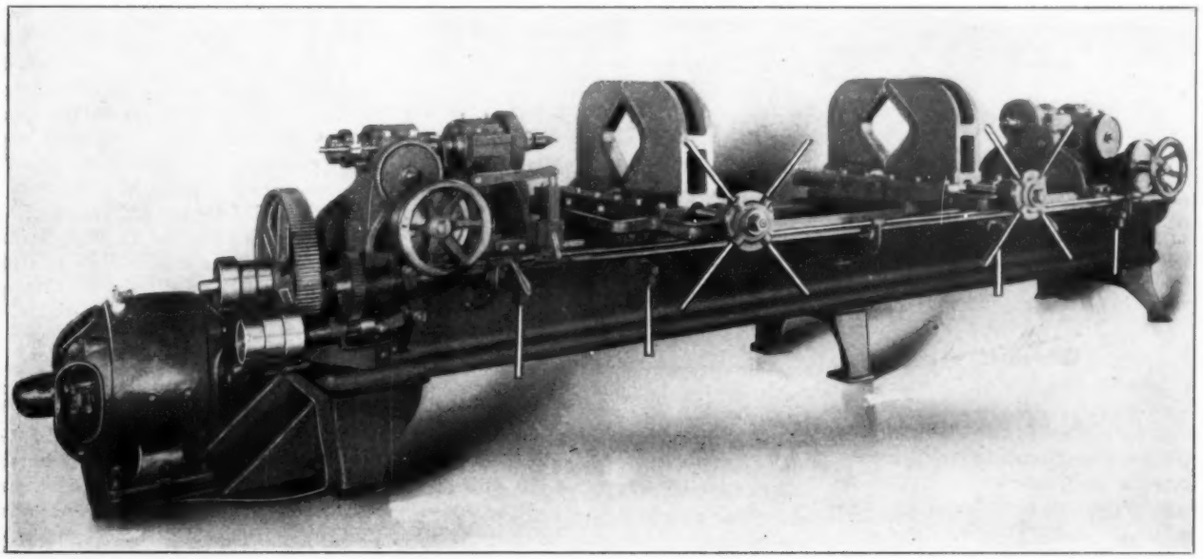
Another international exposition is scheduled for next year. This one, which is to be the largest European exposition ever held outside of Paris, is to celebrate the completion of a famous piece of engineering—the Simplon tunnel; and is to be held in Milan from May to November, 1906. Practically all the European nations, and several of the Asiatic ones, will participate officially. The cost of transporting exhibits from the United States will not be excessive, since Milan is less than 100 miles distant from Genoa, the port of entry.

Double-Head Centering Machine.

The illustration shows a double-head centering machine designed and built by the Nazel Engineering & Machine Works, Philadelphia, Pa.

This machine is primarily intended for centering driving axles of locomotives, but may be used for other axles, as it has a capacity up to 8 feet 6 inches in length, and the chucks will take axles from 4 inches to 14 inches in diameter, inclusive.

The two chucks or vises are self-centering, and are adjustable along the bed. The two centering heads are also adjustable along the bed. The spindles of the centering heads have a travel of 5½ inches, either automatically or by hand, the large hand-wheel in front of the heads being for hand-feed, while the worm-wheels behind these hand-wheels, in conjunction with the worms on the feed shaft, supply the automatic feed.



DOUBLE-HEAD CENTERING MACHINE.

Above the feed shaft—which is the lower shaft running lengthways of the bed—is a feed-release rod. This rod provides for the automatic release of both centering spindles when they have reached a predetermined depth. The capstan wheels in front of the bed are for closing the chuck jaws. The handles hanging down in front of the heads and chucks are ratchet levers for moving the chucks and heads upon the bed. The three-step cone pulleys at the left near the motor give three gradations of feed.

The machine is electrically driven by a 5 horse-power General Electric Company's 220-volt motor, mounted on a bracket bolted to the machine. The pinion on the motor shaft is of raw-hide geared into a spur-gear on the machine, which gives a ratio of 6 to 1.

The machine, including the motor, occupies a floor space 18 feet by 4 feet, and weighs approximately 10,000 pounds.

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Notice.

It now seems probable that the compositors of this city will strike on January 1, 1906, for eight hours' work with nine hours' pay, and the perpetuation of the closed shop.

Since we started our own plant seven years ago, the printers in "machine offices" have been increased four times and those in non-machine offices five times, raising the pay from 30 cents per hour to 39 cents. This new demand, if granted, would raise the pay to 44 cents per hour—nearly 50 per cent.

We believe that the closed shop, with all its restrictions, is doing more to injure all American industries and the men employed in them than any other one thing. We are opposed to it on principle and shall resist it.

We ask our readers and advertisers to be a little lenient with us for delays or other shortcomings in this paper for a few weeks after January 1. We will do our best to make these delays and shortcomings as few and as small as possible.

HILL PUBLISHING COMPANY,
JOHN A. HILL, President.

The Engineering of Visits to Engineering Establishments.

A good many of our younger engineers are now looking for branches of engineering in which they can specialize, and some of them have developed entirely new lines of engineering work. Not because we can persuade ourselves that any great amount of work can be secured or income derived from it, but rather because the need of it is occasionally so very apparent, we venture to suggest to some of these the possibility of specializing in what might be called "The engineering of visits of technical societies to industrial establishments."

The young engineer seeking employment in this field would naturally call upon the proprietors of such establishments as were about to entertain the members of some technical society. This engineer might be imagined as saying something like the following: "In the nature of the case, no one man can ordinarily acquire any great fund of experience in the sort of work which I have undertaken to do unless he devotes his time to it. Your engineers have devoted their attention to other branches of work in which they are, of course, experts. I, on the other hand, have made a special study of the visits of bodies of engineers to industrial establishments. I have gathered the experience of practically all of those who have entertained such bodies; have studied the mistakes made by them, the causes for those mistakes and the reasons for such small degree of success as has been attained in the management of such excursions.

"Usually, and by the plan at present followed, it is practically impossible for the proprietor of a works to get much of an idea of how many people will visit his works at the appointed time. Whatever the number of visitors he may choose to assume will visit him (after conference with the secretary of the society) he may find that he will have on his hands perhaps far fewer than he expected, but usually very many more than he has expected or has provided for. The result is generally more or less unpleasant, both for the manufacturer and for his guests. If a luncheon is provided, the result is virtually a mob. The caterer and his assistants who have undertaken this part of the work, are promptly overwhelmed; the guests, instead of remaining at a decorous distance from the table and waiting to be served by those provided for that work, crowd around the table, help themselves in every imaginable way and stand there and eat, surrounding the table so closely and so compactly as to prevent more than one-fourth of their number reaching the table, though all are frantically endeavoring to do so. They also prevent the waiters from approaching the table for the purpose of obtaining food for others, and, in short, the entire system breaks down. It does this over and over again upon every occasion, it being clearly apparent that some other plan ought to be devised and followed. If an address is to be made, the visitors cannot be stopped from struggling and 'feeding' in time to listen to it, and in the mad fight all ideas of courtesy, of deference to the rights of others and of what is due to the hosts are forgotten.

"Then, in going about the works, there is usually little or no system. Such a systematic round as has been devised by the proprietor or his engineer advisers is largely disregarded. Many of the guests fail to understand it; others, who, understanding it, if possible, still less yet volunteer to guide and direct others, and of course they guide and direct them wrong, the result being confusion worse confounded, many of the guests failing to see those things which they ought to see, and which it is intended they shall see; and, on the other hand, seeing many of the things which they ought not to see, or which, at least, there is no profit or advantage, either to them or to you, in their seeing. Things are explained to some visitors by other visitors who know little or nothing about the things explained, and, naturally, the explanations are wrong; the net result being that only a small fraction of the benefits which might be realized from such visits is realized, and the works gets far less credit than it might easily get if the matter were systematically handled."

Now, of course, in order to render service of value in this line of work, our young engineer would need to inform himself on the subject, and if he happened not to belong to that class of patriots whose patriotism consists solely in stoutly maintaining that everything done in

America is necessarily done better than it could be done elsewhere, he might go to England for some points in connection with his work, and he would find, upon investigation, that they there do these things much better than we do them here. We have referred to this matter before, but it will do no harm to refer to it again.

It is the custom with the English technical societies, which are invited to visit industrial establishments, for them to ask the proprietors of such establishments to state how many people they can comfortably and advantageously entertain. This number is announced in the meetings of the society, and those who desire to go upon any particular excursion or visit are requested to signify their desire by notifying the secretary or inscribing their names upon a list provided for the purpose. When the number of names specified by the host is reached, no more are taken. Those whose names are found upon this list when it is full, or at the end of the time which has been specified, receive, by mail or otherwise, a printed invitation to visit the works in question. When the excursion takes place, only those who have the printed invitation with them are admitted, and, therefore, there is no overcrowding; provision has infallibly been made for properly taking care of those who visit the works, because the number which may be expected is known and proper provision can be made for taking care of them in a comfortable and civilized manner.

This, it may be said, is rather hard upon those who come late to the convention, or who neglect or for any other reason fail to sign their names to the list before the expiration of the prescribed time. That is perhaps true, but, on the other hand, this plan prevents hardship and embarrassment to those who do attend to the matter, and who make the visit of inspection, as well as for their hosts.

The methods followed after the guests have reached the establishment are, in some cases at least, very much superior to anything of the kind we have observed here, and, as an instance of this, we may relate again the method followed by the Willans & Robinson Company, when the members of the English and American mechanical engineers' societies visited its works in 1900.

In this case, a special train conveyed the visitors from London to Rugby, and the time required for the trip was sufficient to enable a luncheon to be served on board the splendidly appointed train of dining cars; so that, upon arrival at the works, this part of the entertainment had been completed. The train stopped alongside of a fence, in which was a gate through which the guests passed. As they passed through this opening, attendants pinned upon the lapel of each coat a badge of a distinctive color, while near-by stood another attendant with a banner of the same color. When the badges of that color had been all pinned upon the coats of entering guests, the man carrying the banner started on a prearranged trip through the works, and was accompanied by those wearing badges of the color corresponding to that of the banner; so that the number in this group had been previously determined, and it consisted of neither more nor less persons than had been designed by those who planned the entertainment. Accompanying this group of visitors was one, or perhaps more, engineers or others familiar with what was going on in the works and competent to explain it, as well as to see to it that the interesting things—those worth seeing—were seen, and fully understood; while, on the other hand, time was not wasted upon unimportant things, or things which for one reason or another there was no advantage in exhibiting. Any member of this group who, for any reason, strayed away from his company could easily find it, because the banner of the color corresponding to his own badge, held aloft, gave him the location of the group of visitors to which he belonged; and in practice it was found upon the few occasions when different groups intersected each other's paths, they automatically separated themselves again and did not combine in a different way and go off, no one knew where, as they always do when the affair is conducted as we do it here. Enough banners and sets of badges were provided to thoroughly take care of the number of guests; this number being, by the means previously described, exactly known and ample and complete provision made for entertaining that number in the proper and in this case, altogether admirable way. Every visitor simply followed his banner, thus every visitor was brought to a predetermined point, at a predetermined time, and finally when the time came for the speech-making, for the tea which was served, or for any other feature of the entertainment which had been provided, all were there at the appointed time, without confusion, without uncomfortable and unseemly crowding, which is such a frequent accompaniment of our own functions of this description; and, in short, the whole affair passed off as such an affair should, and in a manner to reflect credit upon the engineering skill which had been devoted to its planning and its execution.

It seems a pity that we cannot make use of such experience, and thereby relieve ourselves of considerable unpleasant experience. Perhaps we shall eventually do it, and perhaps also without the aid of the highly specialized engineer we have mentioned. We have little hope of any such plan being adopted until those in charge of the affairs of some of our technical societies can develop sufficient backbone to inaugurate it, and can harden their hearts sufficiently to discommode and disappoint the few who, for any reason, cannot sign a list previous to a given hour, for the sake of bringing order out of chaos in connection with such functions, and of contributing very greatly to the enjoyment of them by those who entertain and by those who are entertained.

The Capitalization of Skill.

We have of late been having a good deal of discussion on the subject of capitalization of the skilled trades or professions, and figures have been given showing the relative value of such training, as compared with money in the bank at going rates of interest. It has been assumed that if, for instance, special training enabled a man to earn, say, $500 per year more than he could earn without such training, then this training is worth to him a sum of money which, if placed in the bank or otherwise invested, would return him in interest $500 per year. Of course those who are presenting such figures really think they are right, but there is after all an important difference between the two, and in favor of the money every time. Ten thousand dollars securely invested works all the time whether its owner is sick or well; whether at home or away on a vacation; it continues to work for his heirs after he is gone, and after it has produced its income for many years, it is still available for other purposes if the owner wishes to use it for any other. In all these respects it has the advantage of special training or of special skill, which would enable its possessor to earn an equal amount per year.

Upon reflection most machinists will be able to perceive of several points of difference between their houses and United States battleships, and one of these differences seems to consist in the ability of the latter to move about and to obtain coal supplies in the most favorable markets in the world. It is announced that it has been found that a sort of combination had been entered into by London merchants who control the coal supply in the various ports accessible to our naval vessels, and that the prices were thereby made not only uniform, but uniformly high. Thereupon our naval authorities arranged to procure their coal at other ports where they had not been previously obtaining it, and the outcome of this move it is said is now being awaited with some interest.

The models of the old locomotives which were exhibited at the World's Fair in St. Louis have not yet found a final resting place. They are now in storage at Martinsburg, on the Baltimore & Ohio Railroad, and special provision has been made there for their proper protection. It is proposed that they shall form the nucleus of a railway institute, which may be under the direction of the Baltimore & Ohio Railroad, but nothing definite has yet matured.

New Tools and Machine Shop Appliances.

NEW TOGGLE DRAWING PRESS.

The illustrations show a new toggle drawing press, Fig. 1 being a perspective view and Figs. 2, 3 and 4 elevations showing the link, bell-crank and yoke movement combined, operated directly from the crankshaft. With this movement the required power is obtained with a minimum amount of friction, the result of which is that the least possible belt power is required in operating the press. This movement consists of an arm *A*, the upper end of which is attached directly to the crankshaft, the lower end of the arm being attached to the upper end of a yoke or clevis *B;* the lower end of this clevis being attached to a link *C*, said link being fulcrumed to the lower front side of press frame; to the upper end of the yoke or clevis *B* and straddled by the end of the arm *A* is attached the second arm or link *D*, which is attached or fulcrumed to the rear side of the press frame. Attached to the yoke or clevis *B* are two other links or arms to which two bell-cranks *E* and *F* are attached, these bell-cranks in turn being attached or fulcrumed to the side of the press frame. The upper end of the bell-cranks *E* and *F* are connected with two arms or links *G* and *H*, the upper ends of these arms or links being attached directly to the end of two rocker-arm shafts *J* and *K*, and in this manner operating the toggle movement for the blank-holder of the press.

In the use of the combination of the bell-crank and yoke, the link or arm movement referred to imparts a vertical movement to the yoke or clevis, and a practically perfect dwell during the entire working time of the forming punch or plunger is in this manner obtained.

The front and rear rocker arms at the top of the press frame operating the inner toggle movement are made of steel. A heavy substantial frame connects the toggle movement and outer side or blank-holder. This blank-holder is given a wide range of adjustment by means of the heavy stud or screw at each of the four corners of the outer slide. The crank is connected to the inner plunger or forming punch moving inside of the outer slide or blank-holder by means of a connection and screw. This connection has a cap held in position by four studs bearing perfectly on the threaded portion of screw, and in this way securely clamping the screw and positively preventing the screw from working loose. The adjustment of the screw is obtained by means of a gear, the adjusting pinion being thrown toward the operator to the front of the press, giving free access for an easy quick adjustment.

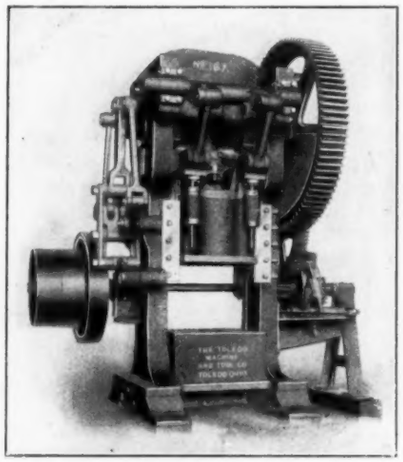

FIG. 1. NEW TOGGLE DRAWING PRESS.

Some of the measures of the press illustrated are as follows:

Weight—44,000 pounds.

Width between uprights—35 inches.

Distance bed to blank-holder, stroke down and adjustment up—16 inches.

Distance bed to plunger, stroke down and adjustment up—18 inches.

Stroke of blank-holder—12 inches.

Stroke of plunger—17 inches.

Adjustment of blank-holder—8 inches.

Adjustment of plunger—8 inches.

Capacity of press for drawing metal—16 gage in thickness, not exceeding 24 inches diameter.

This press is one of ten sizes recently placed on the market by the Toledo Machine & Tool Company, of Toledo, Ohio, ranging in weight from 5,000 to 150,000 pounds, for drawing sheet tin, brass, copper, aluminum, steel and other metals. The one illustrated is known as No. 167.

MOTOR-DRIVEN DRY GRINDER.

A new motor-driven dry grinder, capable of carrying two 12x2-inch emery wheels, has been added to a line which also contains 18x2-inch, 24x3-inch, and 30x4-inch motor-driven grinders.

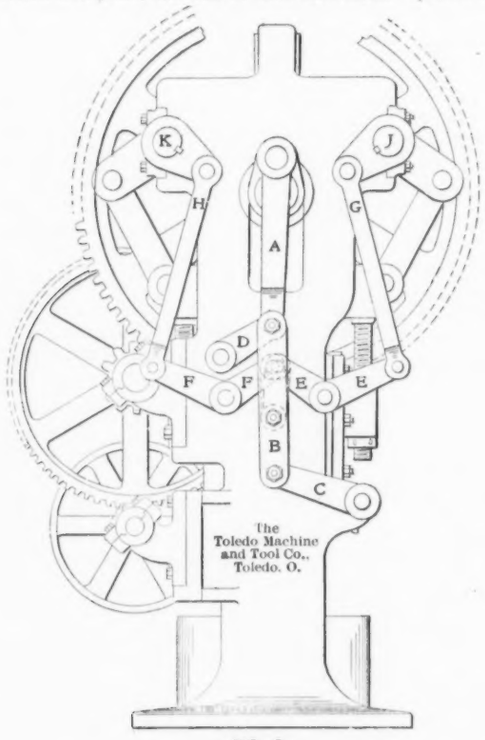

FIG. 2.

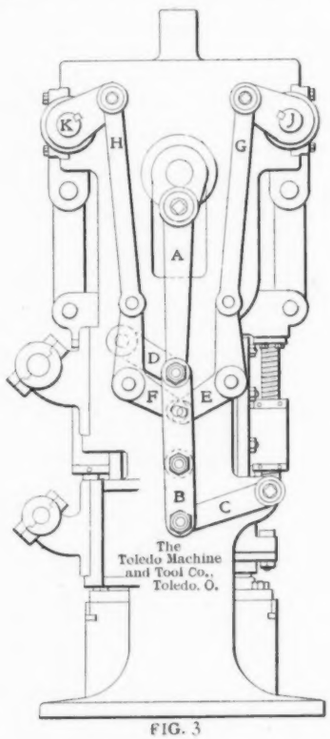

FIG. 3

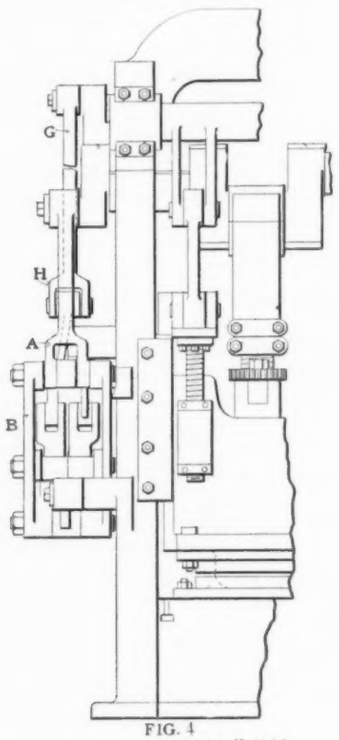

FIG. 4

American Machinist

NEW TOGGLE DRAWING PRESS.

This machine consists of a heavy cabinet base with floor area sufficient to insure steady running; upon this base is mounted an electric motor, which of course is thoroughly enclosed to protect it from dust. The armature shaft, which is of large diameter, is extended in both directions to carry the emery wheels, the wheel seats of the spindle being 1¼ inches diameter. The journals are ring-oiling and run in phosphor-bronze dust-proof boxes. The speed of the wheels is 1,700 revolutions per minute.

Inside the pedestal are mounted the starting box, switch, and non-arcing fuses. The machines can be furnished with motors wound for direct current of any voltage.

Outside of the bearings, at each end of the motor, are fixed the shields or guards for the wheels, which carry the rests for the pieces being ground.

The grinders referred to are made by the Ransom Manufacturing Company, of Oshkosh, Wis.

Personal.

G. E. Pellissier (Worcester Polytechnic, '04), has accepted a position with the Goldschmidt Thermit Company, of New York.

Robert S. Clemons, formerly of Crocker-Wheeler Company, has become associated as a specialist in power-house construction with Dodge & Day, Philadelphia.

C. W. Gregson, of New Bedford, Mass., has accepted the position of foreman of smith shop and steel department of the Union Twist Drill Company, Athol, Mass.

Herbert P. Linnell (Worcester Polytechnic, '94), has been promoted to the position of resident engineer at Colon, in connection with the work of the Isthmian Canal.

The address is wanted of J. S. Stephens, a patternmaker, who formerly had a shop of his own at 27 Penn avenue, Pittsburg, Pa. Will he, or some friend of his, send the address to the editor?

H. E. Barton has connected himself with the Union Twist Drill Company, of Athol, Mass., and will manage their new Chicago store. Mr. Barton was for many years with Samuel Harris & Co., of Chicago.

Business Items.

The Union Twist Drill Company, of Athol, Mass., has opened a store at 68-70 South Canal street, Chicago, Ill., under the management of H. E. Barton, and will carry in stock a full line of milling cutters.

The Hub Machine & Tool Company, of Philadelphia, Pa. (B. F. Lare, general manager), has leased much larger premises at 621 Cherry street, in that city, and will consolidate there the two plants now at South Sixth street and at Discount Place. With the extended facilities this change will give, this company expects to be able to keep more nearly abreast of its orders for small saw tables and the like.

Manufacturers.

Fire destroyed the water-works plant at Lewistown, Ill.

The Peoria (Ill.) Drill & Seeder Company will enlarge its plant.

A machine shop will be built for Conant, Ball & Co., Gardner, Mass.

The Ohio Steel Wheelbarrow Compony, Toledo, O., will erect a new factory.

The plant of the Munson Heater Company, Connellsville, Pa., will be doubled.

A large cold-storage plant is being erected for the Seipp Brewery Company, Des Moines, Iowa.

The Ticonderoga (N. Y.) Electric Light & Power Company will build a large steam plant.

The Schenectady (N. Y.) Railway Company is considering a proposition to erect a new machine shop.

The machine shop of the Republic Iron & Steel Company, on Sylvan Island, Ill., was destroyed by fire.

The foundry of the A. C. Thompson Company, Lunenburg, N. S., was burned to the extent of $20,000.

The Virginia Pipe & Foundry Company, with a capital of $50,000, has been formed at Richmond, Va. Thomas Wheelright, president.

New Catalogues.

H. G. Turley, 214 Locust street, St. Louis, Mo. Catalogue of cast-iron cut spur gears. Illustrated. 5x7, pp. 15, paper.

Watson-Stillman Company, 46 Dey street, New York. Sheets 325, 326, 329, containing description and dimensions of the three styles of coupling bolt forcer made by this company.

Patterson, Gottfried & Hunter, Ltd., 146-150 Centre street, New York. Booklet entitled "Holiday Suggestions," showing toolsets for the automobilist, carpenter, machinist or the mechanically inclined.

Brown & Sharpe Manufacturing Company, Providence, R. I. Catalogue No. 107, describing the very large line of machinists' tools made by this company, including a number of new ones. Illustrated. 6x9, pp. 164, paper.

Cullman Wheel Company, 1022-1026 Dunning street, Chicago, Ill. Catalogue No. 5, containing description and price lists of Cullman spur differentials and automobile and machinery sprockets, Baldwin, Diamond and Whitney automobile chains. Illustrated. 6x9, pp. 16, paper.

The Westinghouse Machine Company, East Pittsburg, Pa. Catalogue descriptive of the Westinghouse standard steam engine, in which the machine is shown in detail and assembled by half-tone engravings. Tables of dimensions, steam consumption, etc., are given. 6x9, pp. 35, paper.

Standard Roller Bearing Company, Forty-eighth street and Girard avenue, Philadelphia, Pa. Catalogue No. 12 of ball and roller bearings. This is very complete, containing standard sizes and weights, price lists and illustrations showng various methods for using these bearings. 4½x7, pp. 88, paper.

Ingersoll-Rand Company, 11 Broadway, New York. Catalogue No. 73, entitled "Water Lifted by Compressed Air." This contains quite a lot of useful information, although it is only intended to convey a general idea of the possibilities of compressed air for pumping water and to outline the general conditions to be met. The Pohle and Saunders air-lift systems are described, and illustrations of air-lift plants are shown. There is also a question blank, which can be filled out and sent to the company, which will gladly make suggestions as to the requirements of any particular case. 6x9, pp. 95, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Punches & dies. Wal.M.Wks., Waltham, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N.J.

Concern making special machinery desires contract for further business. Address Box 846, AMERICAN MACHINIST.

Wanted—Patented mechanical specialties to manufacture and market. R. I. Davidson, 18 Scio st., Rochester, N. Y.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Make us your factory.

Specialties and machinery built to order. Close work; close prices. "Moderate," AM. M.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted—One Brown & Sharpe second-hand automatic screw machine, No. 0; also one No 2. Address, giving time they have been in use and character of work they have been making, also price, George W. Dover Company, Providence, R. I.

Tool Catalogue No. 22. 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

Mechanical adwriter wanted, as chief assistant; must have experience in preparing copy for ads, booklets, etc. The opening is a good one for a man who has the right sort of stuff in him, but he must have an easy and attractive style. Please reply by mail only and send samples (with postage for return), giving age, salary expected at start, experience, present position, etc. The Whitman Co., 127 Duane st., New York.

For Sale.

For Sale—One E. W. Bliss Co.'s power press, their regular style and size, No. 37½. Box 889, AMERICAN MACHINIST.

At Sacrifice—Three 4x36 in. Horner wet tool grinders, first-class condition; also two 2 in. cut-off machines. F. A. Law Machine Co., Hartford, Conn.

For Sale—10-ton crane, 40 ft. span, rope drive; has been tested to 20 tons; very low price for cash. Address Murray Iron Works Co., Burlington, Iowa.

For Sale—One Fellows gear shaper; a 36 in. machine, which has been in use only a year; three sets of arbors included. Address Box 900, AMERICAN MACHINIST.

Inventors have for sale the U. S. patent of a diamond-holder. Advantages: No resetting, diamond cannot be lost, all points can be made use of. Best offer accepted. Box 865, AM. M.

For Sale—One hydraulic platen press with a maximum pressure of 600 tons, including five pumps mounted on separate frame, pulley-driven; dimensions, within uprights, 18x20 inches; cycle, 6 inches per minute. Box 888, AMERICAN MACHINIST.

Business Opportunities.

Small manufacturing company wants superintendent for factory. Must invest $2,000 or $3,000. Good salary. Must be handy about machinery. High standing. No debts. Box 901, AMERICAN MACHINIST.

A No. 1 mechanic, used to small die work or fine assembling, can purchase interest in a manufacturing business established 5 years. Large and profitable orders on hand sufficient to keep factory running for years. Company has machinery and materials worth $25,000, free and clear. Good opportunity for good mechanic with $5,000 to $10,000. Full investigation invited. Address Box 896, AM. M.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach

us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

INDIANA.

Superintendent; age 35; practical machinist; natural ability and wide experience handling men and reducing costs. Box 713, A. M.

MARYLAND.

Designing draftsman (30), 9 years' experience on general machine design and construction, including boilers, engines, rolling mill equipment, dredging machinery, etc.; thoroughly acquainted with best pattern, machine shop and foundry practice; large experience estimating material and figuring costs; has technical education and executive ability; can take entire charge in drawing room or field; at present chief draftsman of prominent concern; good reason for desiring change; would accept responsible position with first-class firm. Address Box 899, AMER. MACHINIST.

NEW JERSEY.

Position wanted by experienced mechanical draftsman. Box 909, AMER. MACHINIST.

As engineer or assistant, by technical graduate, 34; good shop man and designer; young firm with prospects preferred. Box 904, A. M.

Mechanical engineer, technical graduate, 4 years' shop experience, 7 years drafting, all-around mechanic, good reference, desires position as superintendent, assistant, or to travel. Address Box 903, AMER. MACHINIST.

NEW YORK.

Draftsman, experienced general, special machinery; New York or New Jersey preferred. Box 877, AMERICAN MACHINIST.

Mechanical draftsman (German), 27, technical graduate, with 7 years' experience in general machinery, wants to change position. Address Box 906, AMERICAN MACHINIST.

General foreman, responsible man, 36, experienced in high-grade duplicate general and mill machinery, expert machinist, wishes to make change; Pacific States preferred. Box 883, AMERICAN MACHINIST.

Position as superintendent or manager, by good executive and organizer, familiar with modern shop methods, premium and other systems of paying labor; experienced on electrical machinery, engines, boilers, etc., also foundry practice; present position general superintendent. Box 879, AMERICAN MACHINIST.

PENNSYLVANIA.

Chief draftsman, general work, wants position. Box 869, AMERICAN MACHINIST.

Electrical and mechanical engineer, 30, technical graduate, 8 years with best American engineering companies, wants position with railway or large industrial company; expert designer; practical inventor; a man who can do things well. Box 894, AM. M.

I have had 12 years' experience in mechanical lines, in office, drafting room, shop and selling; have good knowledge of advertising and human nature. I am not looking for glory or a cinch, but want the easiest job at the largest salary; advertising or sales manager preferred. Can make good, so don't hesitate to bid for my services. Address Box 884, AMERICAN MACHINIST.

WEST OF MISSISSIPPI.

Draftsman and designer of automobiles, technical graduate, able to design and calculate complete, first-class, up-to-date commercial and pleasure motor vehicles, desires position; good references. Box 887, AMER. MACH.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CANADA.

Cost-clerk, for a manufacturing concern in Canada, employing about 500 men; must be able to improve, if necessary, the system in use at present and to take complete charge of the cost department; applicants, to receive consideration, must state age, experience, present place of employment, salary required and when could engage. Address Box 847, AM. M.

CONNECTICUT.

Wanted—A young man, familiar with drafting, to assist superintendent in an iron casting plant; good opportunity for advancement, if capable. Box 856, AMERICAN MACHINIST.

Wanted—Two floor and two planer hands on heavy work; steady work and good wages; no trouble; only first-class men wanted; state wages and experience. Farrel Foundry & Machine Co., Ansonia, Conn.

Several first-class, all-around machinists are wanted by firm manufacturing elevators, clay-working machinery, friction clutches, etc.; men capable of doing erecting or repair work when required; steady work for right men. The Eastern Machinery Co., New Haven, Conn.

ILLINOIS.

Draftsmen.—We have positions now open for draftsmen. Call or address Western Electric Co., Chicago, Ill.

Wanted—Machine shop foreman; one familiar with hoisting machinery; good salary for good man. Address "B. W.," care AM. MACH.

Wanted—A mechanical engineer to teach machine-shop work in Chicago school, also a mechanical engineer to teach woodwork. Address 5738 Washington ave., Chicago.

Wanted—Experienced designer of large multiple-unit engines for electric lighting and general power purposes, using gasoline, producer gas, etc., for fuel; give full information as to qualifications and salary desired. Box 871, AMERICAN MACHINIST.

Wanted—First-class mechanical draftsman, experienced in mill construction, capable of designing motor and engine drives for same; must be rapid and accurate; permanent if satisfactory; state salary and experience. Address Box 890, AMERICAN MACHINIST.

IOWA.

Wanted—Competent tracers. Murray Iron Works Co., Burlington, Iowa.

MASSACHUSETTS.

Wanted—Fellows gear shaper operators, also turret lathe men. Boston Gear Works, Boston, Mass.

Wanted—Several competent mechanical draftsmen with experience in designing hydraulic machinery; state age and give references. Box 898, AMERICAN MACHINIST.

Several competent machinists wanted, with experience in structural iron work; state age and experience; only those capable of laying out work need apply. Address Box 907, A. M.

Machinists Wanted—We are increasing our force and need good, all-round men on special automatic machinery and jobbing. References as to character and ability required. Apply to L. F. Fales, Walpole, Mass.

MICHIGAN.

Wanted—A first-class diemaker who thoroughly understands making dies for drop forgings; state experience and wages wanted. Bown Machine Co., Ltd., Battle Creek, Mich.

Wanted—3 or 4 first-class, A1 automatic screw machine hands; to experienced men will guarantee steady position and highest rate of wages. Answer, with reference, to Box 85, Detroit, Mich.

Wanted—Experienced machine operator for a new No. 1 Lucas horizontal boring, drilling and milling machine, in Detroit; state experience and wages. Address Box 892, AMERICAN MACHINIST.

MINNESOTA.

Wanted—Die and tool makers and bench hands, accustomed to small, accurate work; must be first class in every respect; highest wages. G. F. Kriesel 2d st. and 5th ave., south, Minneapolis, Minn.

NEW JERSEY.

Wanted—A first-class mechanical draftsman; state experience and salary wanted. Box 881, AMERICAN MACHINIST.

Wanted—A first-class foundry foreman who can make good machinery castings at a reasonable cost; state references and salary expected. Box 891, AMERICAN MACHINIST.

We are increasing our works and want applications for machinist foremen and machinists; in reply give details of experience, age and wages expected. The Edison Portland Cement Co., Stewartsville, N. J.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Foreman; experienced man, to take charge of brass shop, manufacturing fittings, valves and plumbing specialties; give full particulars as to age, experience and salary last received. Box 897, AMER. MACH.

NEW YORK.

Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

Draftsman, capable of designing machinery for lithographers; state age, experience and wages expected; letters confidential. Box 905, AMERICAN MACHINIST.

Wanted—Several first-class toolmakers on dies, jigs and special fixtures for small machine manufacture. Send references to Drawer No. 7, Syracuse, N. Y.

Wanted—First-class tool or die makers on small blanking, forming and drawing dies; none but sober, competent men need apply. Address P. O. Box 196, Albany, N. Y.

Machinists for floor work; must be first-class men who wil appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 859, AMER. MACHINIST.

Wanted—First-class toolmakers on punch and die work; state experience and wages expected. Address Wyckoff, Seamans & Benedict, Remington Typewriter Factory, Ilion, N. Y.

Wanted—Experienced draftsmen, first-class machinists, toolmakers, and gauge makers; give detailed experience, references, age and wages expected. Remington Arms Company, Ilion, N. Y.

We require the services of 20 draftsmen and 10 tracers at once; permanent positions with a well-established concern in N. Y. city; work consists of furnishing detailed manufacturing information for a large shop; previous experience in our line not essential; state age, nationality, experience and salary expected. Address Box 893, AMER. MACH.

Wanted—Young man as assistant to foreman of machine shop; plant within 12 miles of New York city, manufactures general line of power-transmitting machinery, also special work of all kinds; applicant must have had several years' experience in drafting room and 3 or 4 years' experience in machine shop, and must be well recommended. Address, stating age, experience and salary expected, Box 908, AMERICAN MACHINIST.

OHIO.

Wanted—A first-class machine shop foreman, familiar with cranes, hoisting and conveying machinery; state age, experience and salary wanted. Box 902, AMER. MACHINIST.

Wanted—A first-class draftsman; one who is accustomed to the design of medium-weight automatic machinery preferred. Reply, stating experience, reference and salary desired, Box 895, AMERICAN MACHINIST.

Wanted—Mechanical designer and draftsman who is capable of superintending a small shop building butchers' and bakers' machinery; must speak German and English; a very good opportunity. Address "N. E. M.," care AMERICAN MACHINIST.

Wanted—First-class foundry foreman, with executive ability, to take charge of foundry employing 200 hands; medium and light, floor, bench and machine molding; good salary to competent man. Address, with reference, Box 872, AMERICAN MACHINIST.

PENNSYLVANIA.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMERICAN MACHINIST.

Draftsman—A large manufacturing concern in Western Pennsylvania wants first-class draftsmen with experience on steam engines. Box 885, AMERICAN MACHINIST.

Wanted—A number of mechanical draftsmen; those with experience in electrical apparatus, generators or motors preferred; only first-class men need apply. Address Chief Draftsman, Westinghouse Electric & Manufacturing Co., Pittsburg, Pa., P. O. Box 911

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Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

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Ingersoll-Rand Co., New York.

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Ingersoll-Rand Co., New York.

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See Roller Bearings.

Barrels, Steel

Lyon Metallic Mfg. Co., Chicago, Ill.

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Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.

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Niles-Bement-Pond Co., New York.
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Three Rivers Tool Co., Three Rivers, Mich.
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Bars, Boring Cylinder

Underwood & Co., H. B., Philadelphia, Pa.,

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Ellis Co., H. G., Clearfield, Pa.

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Dixon Crucible Co. Jos., Jersey City, N. J.
Shultz Belting Co., St. Louis, Mo.

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Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

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Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
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Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
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Niles-Bement-Pond Co., New York.

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Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolts, Coupling
Cleveland Cap Screw Co, Cleveland, O.
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American School of Correspondence, Chicago, Ill.
Audel & Co., Theo., New York.
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Hill Pub. Co., New York.
Modern Machy. Publishing Co., Chicago, Ill.
Wiley & Sons, Jno., New York.

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Ridgway Dynamo & Engine Co., Ridgway, Pa.
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Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
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Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
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Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
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Ridgway Mach. & Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Bown Mach. Co., Battle Creek, Mich.

Boxes, Tote
Lyon Metallic Mfg. Co., Chicago, Ill.

Brackets, Lamp
Standard Welding Co., Cleve., O.

Bulldozers
Prentiss Tool & Supply Co., New York.
Toledo Machine Tool Co., Toledo, Ohio.
Williams, White & Co., Moline, Ill.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Walker Co., O. S., Worcester, Mass.

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Cams
Boston Gear Works, Boston, Mass.

Carborundum
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Castings, Brass and Bronze
Nolte Brass Co., Springfield, O.
Phosphor Bronze Smelting Co., Philadelphia, Pa.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
Poole Co., J. Morton, Wilmington, Del.
U. S. Foundry & Sales Co., South Norwalk, Conn.
Yale & Towne Mfg. Co., Stamford, Conn.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass
Cullman Wheel Co., Chicago, Ill.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Anderson & Sons Co., Detroit, Mich.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

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American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach Co., Madison, Wis.
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Goodell-Pratt Co., Greenfield, Mass.
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Modern Tool Co., Erie, Pa.

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Morse Twist Drill & Mach. Co., New Redford, Mass.
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Whitney Mfg. Co., Hartford, Ct.
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Cushman Chuck Co., Hartford, Ct.
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Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.

Clutches, Friction
Caldwell, Son & Co., H. W., Chicago, Ill.
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Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
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Reeves Pulley Co., Columbus, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

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Standard Welding Co., Cleve., O.

Compound, Boiler
Advance Mfg. Co., Kalamazoo, Mich.

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Blanchard Mach. Co., Boston, Mass.
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Christensen, N. A., Milwaukee, Wis.
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General Pneumatic Tool Co., Montour Falls, N. Y.
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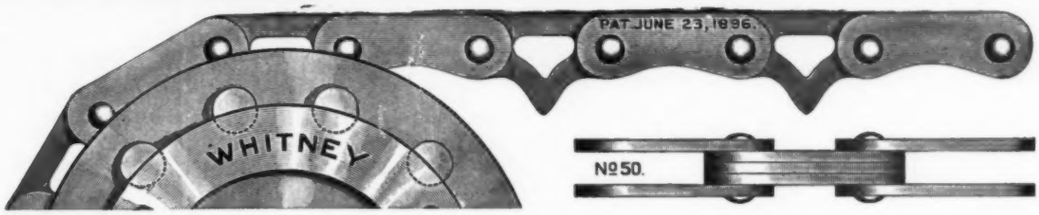
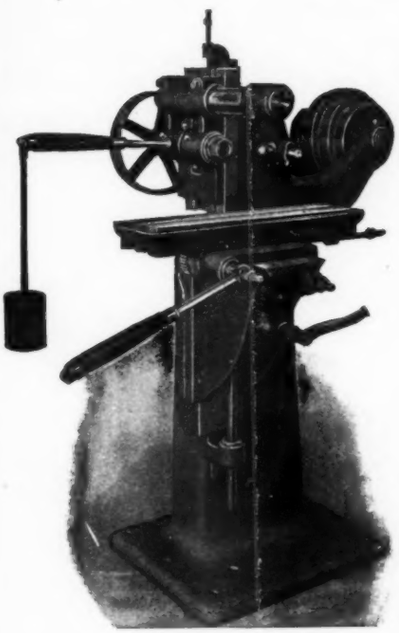
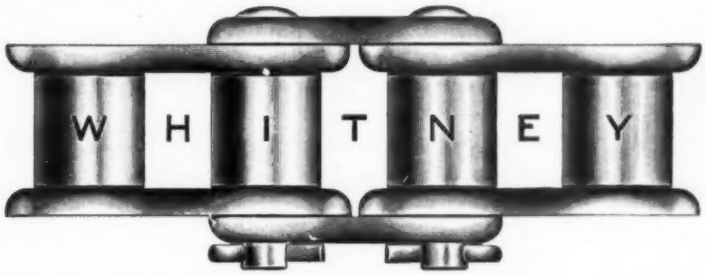
Compressors, Gas
Ingersoll-Rand Co., New York.

Condensers
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

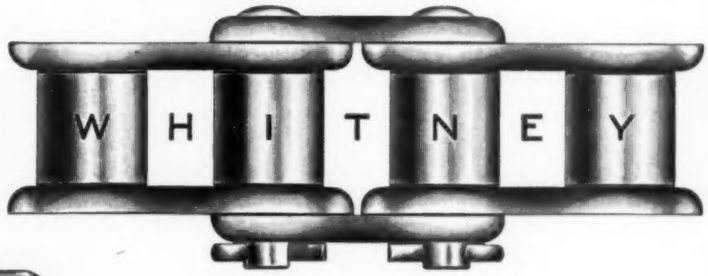


"WIZARD" Chains and Sprockets—Patented

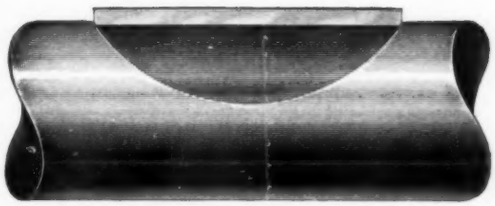




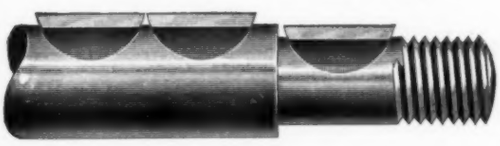
1906 Model "Whitney" Detachable Roller Chains—Patented



Block Chains



"Woodruff" Patent Keys



Three Popular Specialties

"Whitney" Chains
Hand (feed) Milling Machines
The Woodruff Patent System of Keying

THE WHITNEY MFG. COMPANY

HARTFORD, CONN., U.S.A.

FOREIGN AGENTS: C. W. Burton, Griffiths & Co., Great Britain. Schuchardt & Schutte, Germany, Austria, Holland, Russia and Scandinavia. Fenwick, Freres & Co., France, Belgium, Italy, Switzerland, Spain and Portugal

Conduit, Interior
Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

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Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Provi., R. I.

Counters, Machinery
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

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Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

Couplings, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Standard Gauge Steel Co., Beaver Falls, Pa.
Woods Sons, T. B., Chambersburg, Pa.

Cranes
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.

Cranes, Portable
Franklin Portable Crane & Hoist Co., Franklin, Pa.
Nicholls, Wm. S., New York.

Crank Pin Turning Machine
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa

Crank Shafts
Erie Forge Co, Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles
Dixon Crucible Co., Jos., Jersey City, N. J.

Crushers
Ingersoll-Rand Co., New York.
Link-Belt Engineering Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups and Covers, Oil
Bay State Stamping Works, Worcester, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Winkley Co., Hartford, Conn.

Cut Meters
Warner Instrument Co., Beloit, Wis.

Cutters, Milling
Adams Co., Dubuque, Iowa.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Ingersoll Milling Mach. Co., Rockford, Ill.
International High Speed Steel Co., New York.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Standard Tool Co., Cleveland, O.
Union Twist Drill Co., Athol, Mass.
Whitney Mfg. Co., Hartford, Ct.

Cutting-off Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Fawcus Mach. Co., Pittsburg, Pa.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
Newton Mach. Tool Wks., Philadelphia, Pa.
Nutter, Barnes & Co., Boston, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Cutting-off Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
O. K. Tool Holder Co., Shelton, Conn.
Pratt & Whitney Co., Hartford, Conn.

Cyclometers
Veeder Mfg. Co., Hartford, Conn.

Diamond Tools
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Dies, Sheet Metal
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Kent & Co., Edwin R., Chicago, Ill.
Toledo Machine Tool Co., Toledo, Ohio.

Dies, Sub-Press
Risdon, S. A., Waterbury, Conn.
Waltham Machine Works, Waltham, Mass.

Dies, Threading, Opening
Errington, F. A., New York.
Geometric Tool Co., New Haven, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Modern Tool Co., Erie, Pa.

Dies, Threading, Opening *Continued*
Pratt & Whitney Co., Hartford, Conn.
Reliance Mach. & Tool Co., Cleveland, O.
Swaine Co., Fred J., St. Louis, Mo.

Dowel Pins
Winkley Co., Hartford, Conn.

Drafting Machines
Universal Drafting Mach. Co., Cleveland, O.

Drawing Boards and Tables
Rich, J. & G., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drawing Instruments
Alteneder & Sons, Theo., Philadelphia, Pa.
Keuffel & Esser Co., New York.

Drawing Materials
Rich, J. & G., Philadelphia, Pa.

Drift Bolt Drivers
Ingersoll-Rand Co., New York.

Drilling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
McGeorge & Sons, Cleveland, O.
Patterson Tool & Supply Co., Dayton, O.
Pratt & Whitney Co., Hartford, Conn.

Drilling Machines, Boiler
American Tool Wks. Co., Cin., O.
Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drilling Machines, Multiple Spindle
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fenn-Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mchy. Co., Chicago, Ill.
McCabe, J. J., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Three Rivers Tool Co., Three Rivers, Mich.

Drilling Machines, Portable
Cincinnati Elec. Tool Co., Cin., O.
Coates Clipper Mfg. Co., Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York

Drilling Machines, Radial
American Tool Wks. Co., Cin., O.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Dreses Mach. Tool Co., Cin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
McCabe, J. J., New York.

Drilling Machines, Radial *Continued*
Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

Drilling Machines, Turret
Niles-Bement-Pond Co., New York.

Drilling Machines, Upright
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Barnes Co., B. F., Rockford, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
Cincinnati Mach. Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Fairbanks Co., New York.
Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
Hill, Clarke & Co., Boston, Mass.
Hoefer Mfg. Co., Freeport, Ill.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley Machine Tool Co., South Bend, Ind.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Whitney Mfg. Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Drills, Center
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Providence, R. I.
Standard Tool Co., Cleveland, O.

Drills, Hand
Dallett Co., Thos. H., Phila., Pa.
Cincinnati Electrical Tool Co., Cincinnati, O.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
General Pneu. Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co, Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

Drills, Rail
Foote, Burt & Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Standard Tool Co., Cleveland, O.

Drills, Ratchet
Armstrong Bros. Tool Co., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers, Boat, Gauge & Drill Wks., John M., Gloucester City, Mass.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co, Madison, Wis.

Drills, Spindle
Three Rivers Tool Co., Three Rivers, Mich.

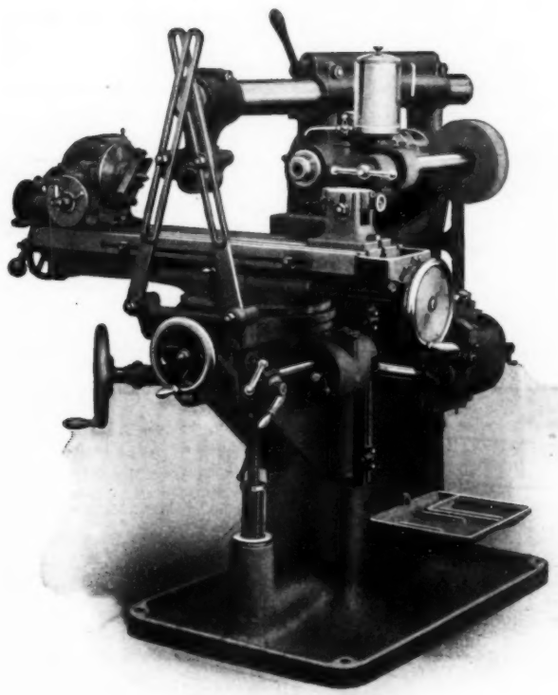
BROWN & SHARPE MFG. CO.,

Providence, R. I., U. S. A.

ADVANTAGES OF USING

B. & S. Universal Milling Machines

For Cutting Spirals, Fluting Reamers, and Milling Spiral Cutters.



The range of the swivel table is sufficient to allow the cutting of any lead generally used.

The saddle that carries the table can be rigidly clamped to it by 3 T bolts that slide in a circular slot of large diameter.

The bearings of the table in the saddle are amply proportioned to insure rigidity.

The swivel is graduated to half degrees, for convenience in setting the table to the desired angle.

The table has quick return operated from the right-hand end by an internal gear and pinion, of ample leverage to secure ease of manipulation.

The feed screw is not splined, thus the thread is unbroken and the original accuracy of the screw maintained.

The spiral head is rigidly constructed. The worm wheel is of comparatively large diameter, and, as it is not disengaged from the worm, the extreme accuracy is not impaired.

The Universal Milling Machine Pamphlets, showing all the machines and giving full specifications, sent upon application.

Drying Apparatus
Sturtevant Co., B. F., Hyde Park, Mass.

Dynamos
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincin., O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Dynamotors
Sprague Elec. Co., New York.

Electrical Supplies
Cutler-Hammer Clutch Co., Milwaukee, Wis.
Electro Dynamic Co., Bayonne, N. J.
General Elec. Co., New York.
Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Electrically Driven Tools and Machinery
American Tool Wks. Co., Cin., O.
Cincinnati Electrical Tool Co., Cincinnati, O.
Crescent Forgings Co., Oakmont, Pa.
Hisey-Wolf Mach. Co., Cincin., O.

Elevators
Albro-Clem Elevator Co., Philadelphia, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.

Emery Wheels
See Grinding Wheels.

Emery Wheel Dressers
Desmond-Stephan Mfg. Co., Urbana, O.
Francis & Co., Hartford, Conn.
Heald Machine Co., Worcester, Mass.
International Specialty Co., Detroit, Mich.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.

Enclosures, Tool-room
Merritt & Co., Philadelphia, Pa.

Engineers, Consulting and Mechanical
Dodge & Day, Philadelphia, Pa.

Engineers, Electrical
Crocker-Wheeler Co., Ampere, N. J.

Engines, Automobile
Franklin Mfg. Co., Syracuse, N. Y.
Olds Gasoline Engine Works, Lansing, Mich.
Reeves Pulley Co., Columbus, O.
Robertson Mfg. Co., Buffalo, N. Y.

Engines, Gas and Gasoline
Automatic Mach. Co., Bridgeport, Conn.
Backus Water Motor Co., Newark, N. J.
Blaisdell Machinery Co., Bradford, Pa.
Brown-Cochran Co., Lorain, O.
Columbus Mach. Co., Columbus, O.
Foos Gas Engine Co., Springfield, Ohio.
Jacobson Mach. & Mfg. Co., Warren, Pa.
Mietz, August, New York.
New Era Gas Engine Co., Dayton, Ohio.
Olds Gasoline Engine Wks., Lansing, Mich.
Struthers-Wells Co., Warren, Pa.

Engines, Oil
Mietz, August, New York.

Engines, Steam
Buffalo Forge Co., Buffalo, N. Y.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Struthers-Wells Co., Warren, Pa.
Sturtevant Co., B. F., Hyde Park, Mass.

Engraving Machinery
Gorton Mach. Co., Geo., Racine, Wis.

Engravings
Springfield Photo-Engraving Co., New York.

Exhaust Heads
Sturtevant Co., B. F., Hyde Park, Mass.

Exhibition, Machinery
Philadelphia Bourse, Phila., Pa.

Expanders, Boiler Tube
Nicholson & Co., W. H., Wilkesbarre, Pa.

Fans, Electric
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Fans, Exhaust
Buffalo Forge Co., Buffalo, N. Y.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Feathers
Standard Gauge Steel Co., Beaver Falls, Pa.

Files and Rasps
Barnett Co., G. & H., Phila., Pa.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Nicholson File Co., Prov., R. I.
Reichheim & Co., E. P., New York.

Filing Machines
Detrick & Harvey Mach. Co., Baltimore, Md.
Henry & Wright Mfg. Co., Hartford, Conn.

Filler, Iron
Clark Cast Steel Cement Co., Shelton, Conn.

Fillets, Leather
Cleveland Fillet Co., Cleveland, O.

Flexible Shafts
Chicago Flexible Shaft Co., Chicago, Ill.
Coates Clipper Mfg. Co., Worcester, Mass.

Forges
Boynton & Plummer, Worcester, Mass.
Bradley & Son, C. C., Syracuse, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Ingersoll-Rand Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Forgings, Drop
Billings & Spencer Co., Hartford, Conn.
Crescent Forgings Co., Oakmont, Pa.
Williams & Co., J. H., Brooklyn, N. Y.
Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

Forgings, Steel
Baldwin Steel Co., New York.
Crescent Forgings Co., Oakmont, Pa.
Erie Forge Co., Erie, Pa.
Heppenstall Forge & Knife Co., Pittsburg, Pa.

Forgings, Steel—*Continued*
Kent & Co., Edwin R., Chicago, Ill.
Tindel-Morris Co., Eddystone, Pa.
Wyman & Gordon, Worcester, Mass.

Foundry Furnishings
Adams Co., Dubuque, Iowa.
Ingersoll-Rand Co., New York.
Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Mass.

Fuel Economizers
Sturtevant Co., B. F., Boston, Mass.

Furnaces, Annealing and Tempering
American Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

Furniture, Machine Shop
Merritt & Co., Philadelphia, Pa.
New Britain Mach. Co., New Britain, Conn.

Gas Blowers and Exhausters
Sturtevant Co., B. F., Boston, Mass.

Gauges, Recording
Bristol Co., Waterbury, Conn.

Gauges, Standard
Brown & Sharpe Mfg. Co., Providence, R. I.
Henry & Wright Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gauge & Drill Works, Gloucester City, N. J.
Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

Gauges, Steam
Lunkenheimer Co., Cincinnati, O.

Gear Cutting Machinery
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Bickford Drill & Tool Co., Cin., O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
Gisholt Mach. Co., Madison, Wis.
Morse Twist Drill & Mach. Co., New Bedford, Mass.

Gears, Cut
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Davis, Rodney, Philadelphia, Pa.
Earle Gear & Mach. Co., Philadelphia, Pa.

Gears, Cut—*Continued*
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Morse, Williams & Co., Phila., Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Wks., Philadelphia, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburg, Pa..
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

Gears, Worm
Albro-Clem Elevator Co., Philadelphia, Pa.
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Generating Sets
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Boston, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Rivett-Dock Co., Boston, Mass.

A 600,000-Pound Screw-Testing Machine.

EDITORIAL CORRESPONDENCE.

The accompanying illustrations show a superb testing machine of 600,000 pounds capacity which was recently completed by the Riehlé Brothers Testing Machine Company for the University of Illinois. It was designed to meet the requirements of Professor Talbot, of that institution, in making certain investigations which he has in contemplation.

The general appearance and many of the details of construction will be gathered from the half-tone, Fig. 1. The most striking feature is the use of a set of guide columns outside the weighing columns, in order to resist the side strains due to eccentric loading. The relation of these two sets of columns is better shown in the plan of Fig. 2, in which *a a* are the weighing columns and *b b* the guide columns, while *c c* are the straining screws. The weighing columns stand on the weighing platform *d*, while the guide columns pass by the platform and stand on the foundation. The weighing head *e* may be secured in three positions on the weighing columns, in order to accommodate specimens of different lengths by passing heavy bars through holes *f g h* in the columns, as shown more clearly in Fig. 1, the screws and pulling head *i* being used to transfer the weighing head from hole to hole. The pulling head has extensions *j*, which fit and are guided by the guide

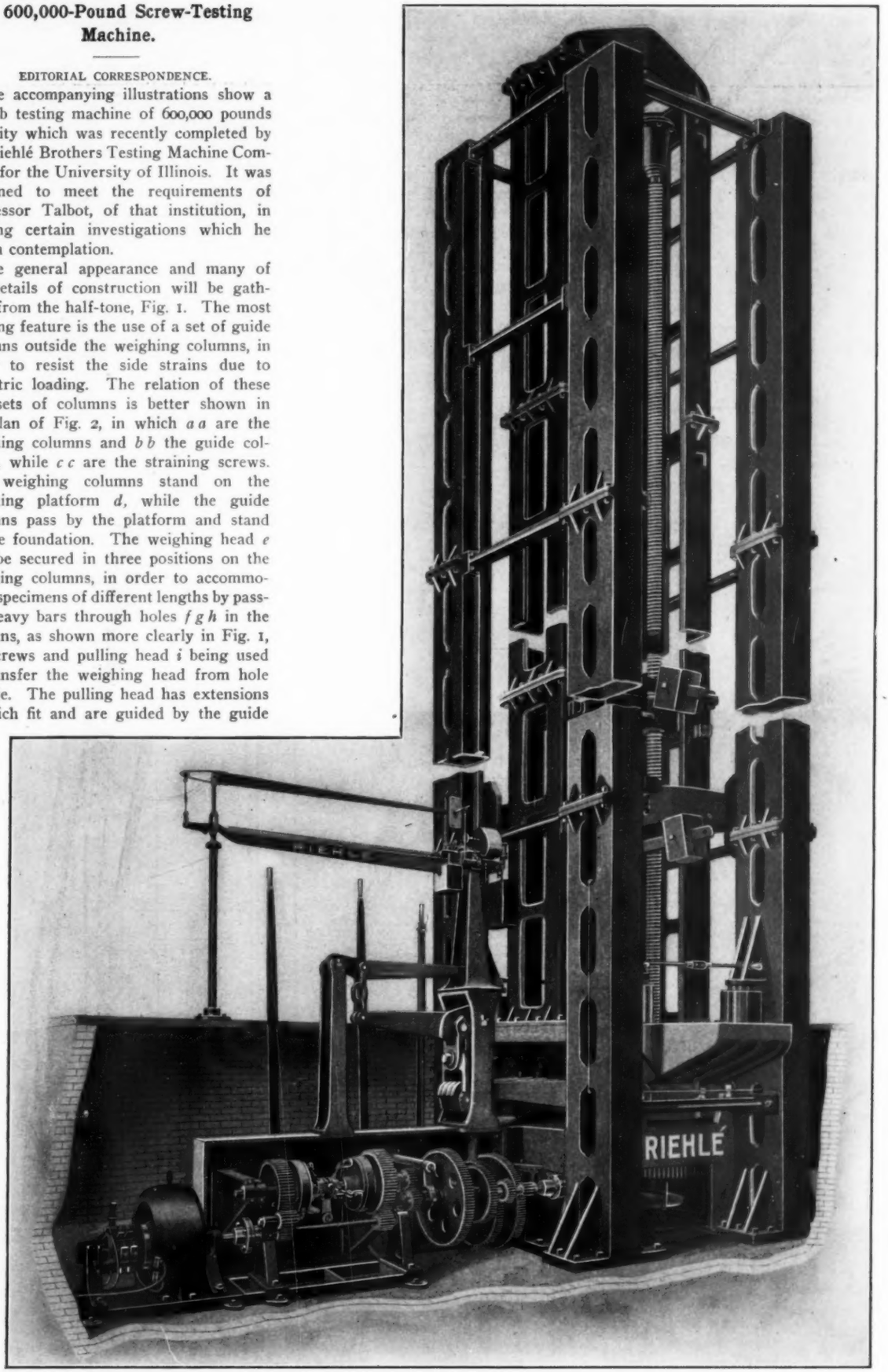
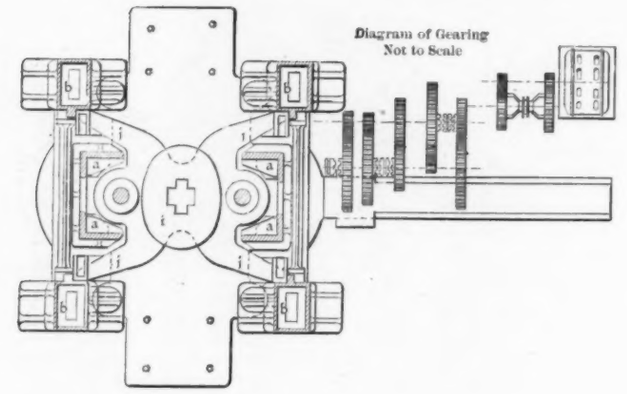


FIG. 1. 600,000-POUND SCREW-TESTING MACHINE.

columns. In the case of compression tests the specimens are placed between this head and the platform, and, if long, any ecentricity of the piece would tend to deflect the head sidewise. Such tendency is, of course, resisted by the guide columns, and a moment's reflection will show that any friction of the head in the guides does not affect the accuracy of the readings. In ord r to combine the lateral strength of the guide columns, they are tied together in one plane by fixed tie pieces, clearly shown in Figs. 1 and 2. Tie pieces are also provided for the other plane, but to facilitate the insertion and removal of long specimens, the second set is made removable. In the case of tension tests the specimens are placed between the pulling and weighing heads, the latter be-



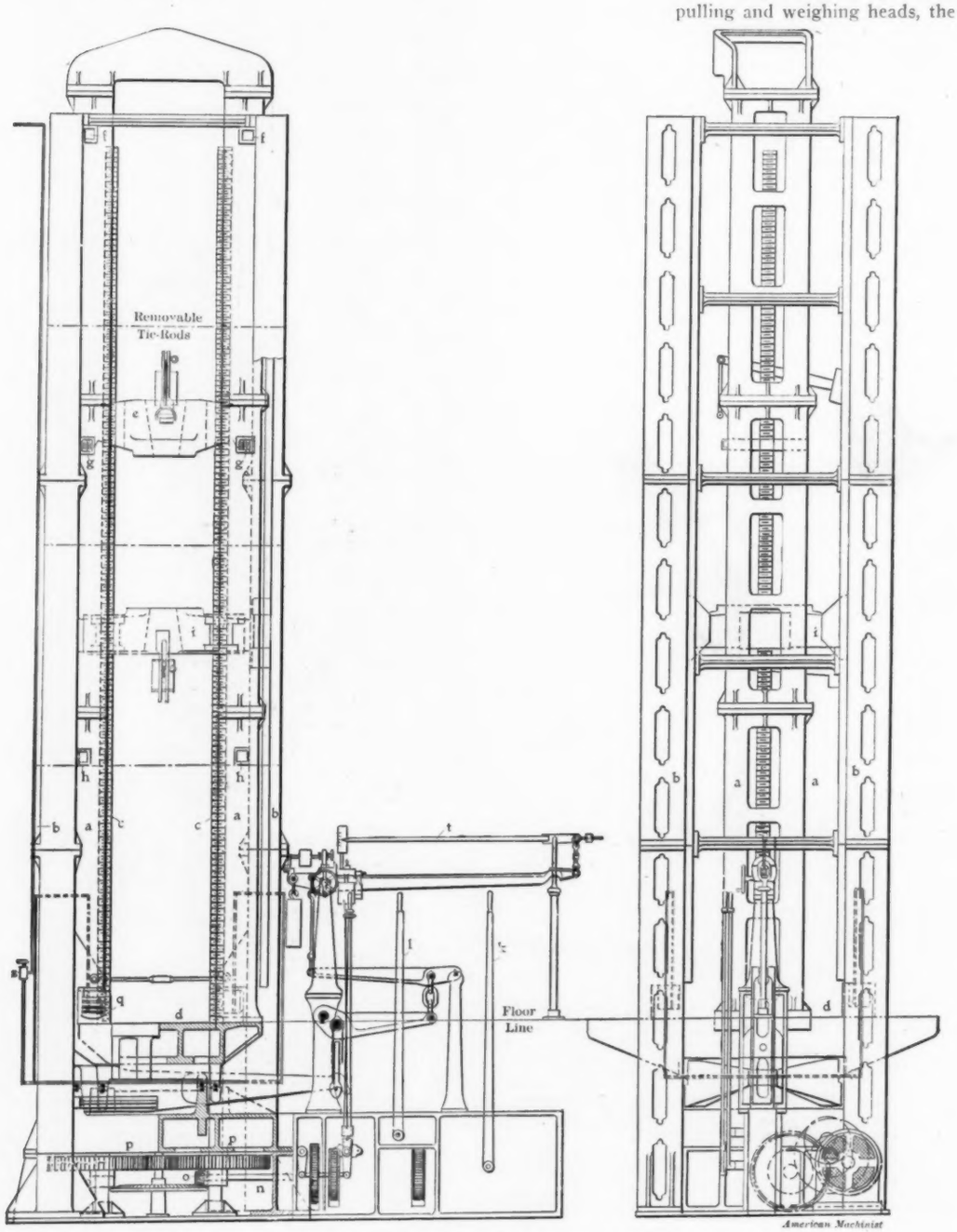


FIG. 2. 600,000-POUND SCREW-TESTING MACHINE.

ing carried at a suitable height in the weighing columns, and with such specimens eccentric loading is not to be anticipated.

The general arrangement of the driving gearing will be apparent from Fig. 1. The 15-horse-power motor is geared to two friction clutches, being connected to one directly and to the other through an intermediate idler, so as to reverse the motion. The motor runs continuously, and the machine is stopped, started and reversed by manipulating the clutches through the lever above them, shown at *k*, Fig. 2. The other levers *l* and *m* operate clutches by which various combinations of gearing are thrown in to give six speeds, the levers being suitably interlocked. From these gears the motion is carried through shaft *n* and bevel pinion *o* to the main gears *p*, which are mounted on the screws. The thrust due to applying the load is carried by flat roller bearings between the main gears and the cover plate. The reverse thrust, when running idle, due to the weight of the screws and the pulling head, is taken by collars on the screws, which bear on the upper side of the cover plate.

The form and arrangement of the main weighing levers is shown in Fig. 3, the method of supporting these levers and of supporting the weighing platform upon them being shown in Fig. 2. Each knife-edge must carry 150,000 pounds, the load per inch of length being 9,700 pounds, which is well within the standard specification of Lloyd's Register of 5 long tons per inch. The cross-section at *K L* will indicate how very effectively the knife-edges are supported and backed up. The center lines of the various levers will show how the centers of the three knife-edges of the various levers are in straight lines, thus insuring uniform load on all parts of the knife-edges and reducing the twisting strain on the levers to a minimum. The construction of the main lever clevis is shown in Fig. 4, and the connection with the intermediate levers, the weighing beam and the needle beam are shown in Fig. 2.

A novel feature of the machine is the system of oil cylinders for absorbing the shock of recoil when the specimen breaks. One of these cylinders is clearly shown in Fig. 1 and also at *q*, Fig. 2. The cylinders, of which there are four, stand on the weighing platform, while their plungers are carried on brackets cast with the guide columns. Holes through the plungers are connected by a series of branch pipes with the main pipe *r*, which connects with an elevated oil tank. A needle valve *s* in this pipe offers resistance to quick passage of the oil, but none to slow passage. During the slow descent of the platform, due to the application of the load, the cylinders are drawn down on their plungers, the oil following the movement and keeping the cylinders full; but on the sudden release of the load, due to the rupture of the specimen, the resistance of the needle valve restricts the flow of the oil, and thus absorbs the shock. It will be observed that the valve, being in the main pipe, insures equal pressure in the branches, and hence involves true balance between the cylinders.

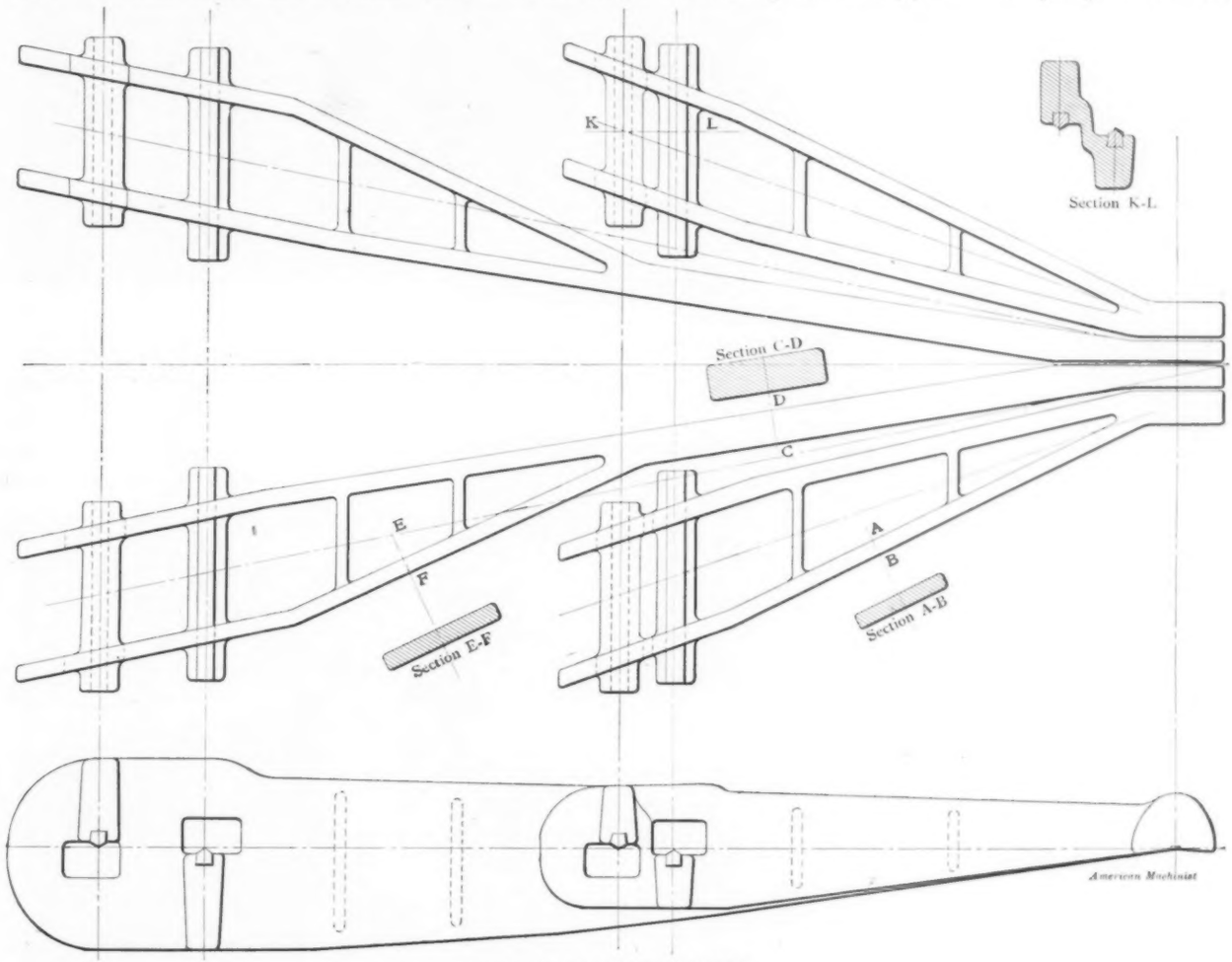


FIG. 3. MAIN WEIGHING LEVERS.

Two poises are used, one giving 1-10 the indications of the other, and two speeds of traverse of the poises are provided. The machine has a Riehlé dial-screw beam, graduated in 10,000 pounds for the large poise, and in 1,000 pounds for the small one. Much finer readings are obtained by a graduated dial on the hand-wheel by which the poises are traversed. A needle beam *t* magnifies the swing of the weighing beam and increases the sensitiveness of the machine. This sensitiveness is remarkable. When loaded to 500,000 pounds, Professor Talbot

stepped on the weighing table and was weighed to within one-half a pound.

The machine has been used for breaking specimens involving loads up to 420,000 pounds, at which load the rupture of the specimen involved no perceptible jump of the weighing parts. The action of the guide columns in resisting the thrust due to eccentric loading when testing compression specimens, has been found to exceed expectations, as has the response of the machine to small increments of load at all points within its capacity.

The machine is adapted to testing compression specimens up to 25, tensile specimens up to 22 and transverse specimens up to 10 feet long. The tools for handling tensile specimens have a capacity for round or square specimens up to 6 inches round or square, and flat specimens up to 4x12

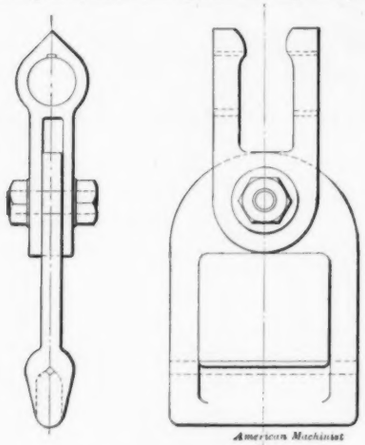


FIG. 4. MAIN LEVER CLEVIS.

inches. The speeds of operation are .05, .1, .4, 1, 2 and 8 inches per minute, the fastest speed being intended as a traverse speed for adjusting the head. The screws, which were cut at the Philadelphia shop of the Niles-Bement-Pond Company, are of 5½ inches outside diameter by about 33 feet long, with about 27 feet of thread.

F. A. H.

The total expenditures of New York city for the year 1906 will be nearly $117,000,000. The total budget as adopted by the Board of Estimate and Appropriation on October 31 is $116,805,490. This is an increase of about $7,000,000 over the appropriations for 1905. The largest items of this increase are for schools and for interest on the city debt, each of which amounts to over $1,350,000. Another additional million goes for increased expenditures in the Police and Fire Departments.

The Correspondence School of Automobile Engineering, formerly of Akron, Ohio, is now established in the "Flatiron" Building, New York city. It has recently been reorganized, and incorporated under the laws of the State of New York, with a capital of $30,000.

The Works of the F. Wesel Manufacturing Company.

The F. Wesel Manufacturing Company, of Brooklyn, New York, which makes all machines and tools used by electrotypers and stereotypers, and a large majority of the machines, tools and materials used by printers and photo-engravers, recently celebrated its twenty-fifth anniversary. As may be imagined, its products are quite varied, and as they occupy such a prominent place in their line, and the order, cleanliness and system in the factory are so conspicuous, we feel that the accompanying views of portions of the establishment will be of interest. The factory is particularly notable in that it employs the individual motor drive throughout. It is located in Brooklyn, near the entrance to the Brooklyn Bridge.

A portion of the buildings occupied by the company was formerly the Twenty-third Regiment armory of the National Guard of New York, dating back to the days before the Civil War; this building was remodeled and enlarged, though its external appearance was pretty well preserved, and additions were built harmonizing in architecture with the armory. In addition to this group of buildings, the company has a four-story building on the other side of Henry street, which is used as a warehouse, one floor being a showroom, the various machines contained therein being equipped with motors and wired to allow of their being used for demonstration purposes.

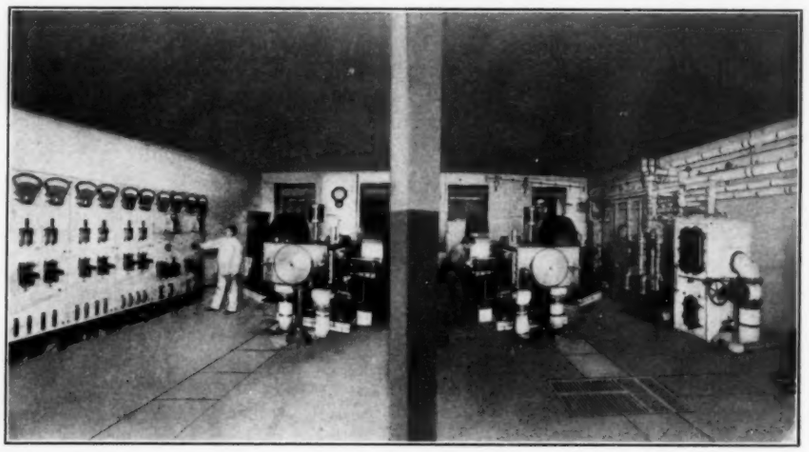


FIG. 1. ENGINE AND GENERATOR ROOM.

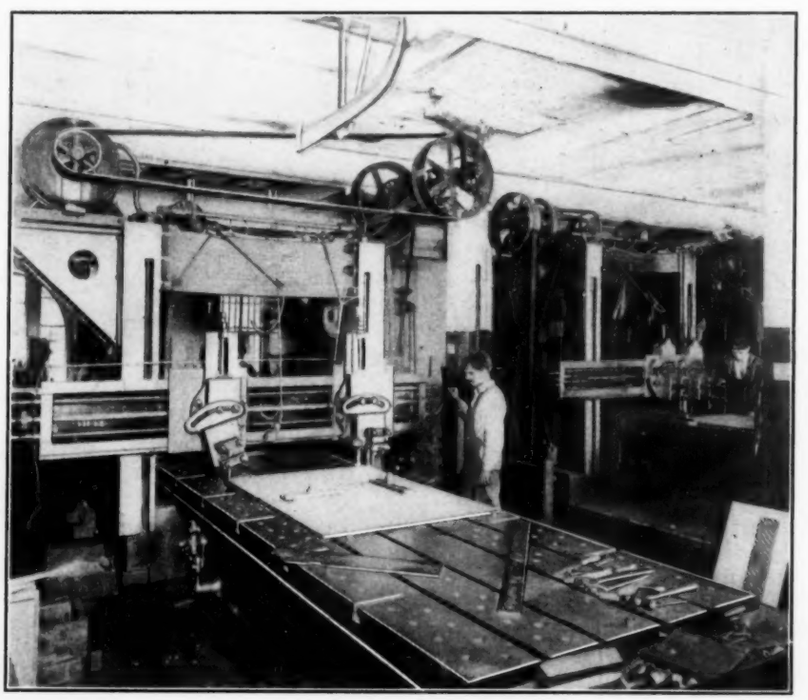


FIG. 2. VIEW IN PLANER ROOM.

The principal departments on the dif-

ferent floors of the main building are disposed as follows:

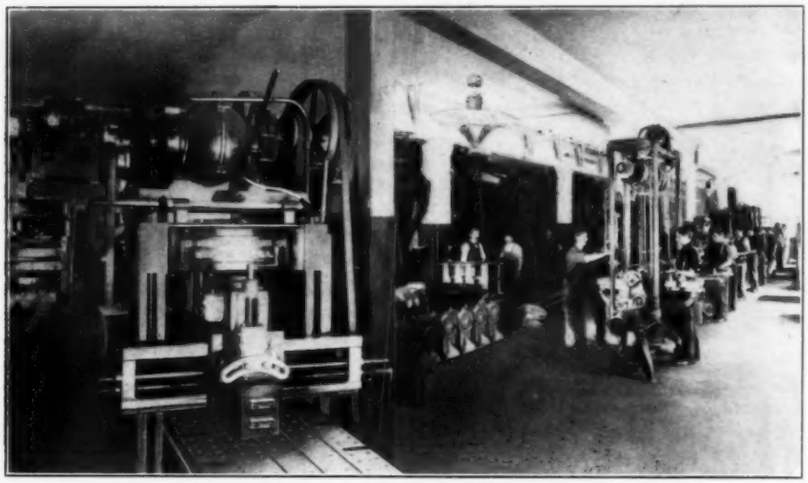


FIG. 3. PLANER DEPARTMENT.

The power plant (including an electric storage battery), blacksmith shop and some minor departments are in the basement.

The first floor is occupied by a machine shop, containing planers, milling machines and shapers; the electrically welded chase department and the shipping department.

The second floor contains the main offices, drafting room and an erecting room.

The third floor contains lathes, brass-rule department and galley department and factory stock room.

The fourth floor contains the small-tool department, assembling department, printing and advertising department.

On the fifth floor is the carpenter shop, pattern shop and stereotype-block department.

The current for the motors which drive the machines all through the works is supplied by two 100-kilowatt direct-current generators in the basement, shown in Fig. 1, driven by two 150 horse-power Watertown high-speed engines, direct coupled to them. The current has an electromotive force of 230 volts, and is distributed to the different manufacturing departments through eight marble switchboards. There are 192 motors in use, the combined rating of which is about 375 horse-power; in adition to which there are about 475 incandescent lamps of 16 candle-power each, and 8 arc lights of 160 candle-power each. The warehouse is not included in this statement.

Alongside of the dynamo room is located a small storage battery which supplies current for the lighting system after working hours. The battery has a capacity of 40 amperes for eight hours, or sufficient to run 160 sixteen-candle-power incandescent lights for that period of time.

The plant is conspicuous for the thorough manner in which driving the machinery by shafting has been replaced by individual motor drives. The average load carried by the generators is about 150 horse-power, although the rating of the motors aggregates not far from 400 horse-power, and, according to the experience of the company, the amount of

FIG. 4. STOCK RACKS FOR SMALL PARTS.

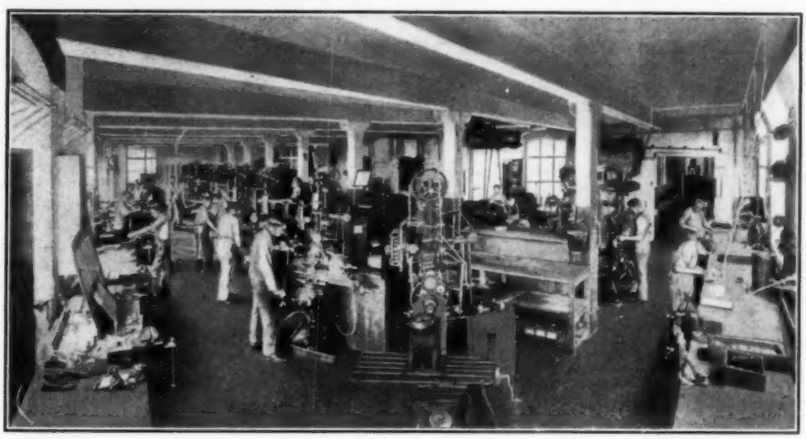


FIG. 5. SMALL-TOOL DEPARTMENT.

power which would be consumed by the same machines driven by shafting and belts is estimated at 300 horse-power; hence the saving in power is, roughly, 50 per cent. This does not take account of the times when there is an exceptionally heavy power consumption, as, for instance, when the chase-welding machines are making a heavy demand for current.

The sum of the horse-power ratings of the motors on the different floors, for buildings *A* and *B*, is as follows, approximately: Basement, 81 horse-power; first floor, 121 horse-power; second floor, 14 horse-power; third floor, 89 horse-power; fourth floor, 45 horse-power; fifth floor, 25 horse-power.

As the work done in the establishment

is, in general, moderate or quite small in weight, there is not much necessity for very powerful motors.

The illustrations show pretty well the gain in lighting, space and facility of arrangement of the machinery, resulting from the motor drive. This is particularly well shown in Fig. 5, the small-tool department. The diagonal arrangement of the milling machines allows of placing seven machines in the space which ordinarily would serve for but five, being equivalent to an increase of floor space of 40 per cent., and moreover the lighting of the work is as good as it could be. In Fig. 8, the electric-welded chase department, the absence of the encumbrance of shafting, pulleys and belts in the upper part of the picture is very noticeable. The only overhead fixtures in the entire factory are for small grinding machines in the lathe department, and the small-tool department (see Fig. 5, for the latter), the design of which necessitated overhead belts; the machines are, however, driven by their own individual motors.

The power plant contains a motor-generator set for supplying alternating current for the electric welding machines. This consists of a 50 horse-power motor driving a three-phase alternator, developing an electromotive force of 320 volts, and capable of a current of 2,000 amperes.

The process of making printers' chases, which is carried on upon the first floor, is an interesting feature of the plant. These chases are made of bars of wrought iron welded together to form a rectangular frame, in some cases with intermediate cross-bars. There being innumerable varieties of chases, due to their varying sizes and the different weights of iron used in their construction, they are not, in general, kept in stock, but are made to order, the construction being rapidly accomplished. The bars are sawed to length and planed on one side, or on both sides if for center bars; some chases are made finished all over. With

FIG. 6. PATTERN SHOP.

the exception of trimming at the corners after welding, this is the only finish the material receives, as the process followed in assembling the bars insures sufficient accuracy in the completed chase.

The electric welding machine can be seen in the background on the left side of Fig. 8. Fig. 9 is a view of a portion of it showing two bars clamped at right angles to each other in the machine. This setting having been satisfactorily accomplished, the operator by pressure on a pedal turns on the current, an alternating current of 320 volts, the average current strength being 300 amperes, but sometimes running as high, on a heavy job, as 500 amperes. In a few seconds the ends of the bars in contact reach a white heat, and the mechanical pressure, which is continually applied, forces them into a perfect union. In watching this process it is noticeable that though the heat at the point of union is so intense, it does not travel for any great distance along the bar, so that the operator is able to handle the material with bare hands, and moreover he does not receive electric shocks from doing this, even though he touches both bars. The chase is joined one corner at a time, and after each weld the bars are taken out of the electric forge and clamped in a right-angle vise, being thus allowed to cool perfectly square.

After the four corners have been welded together the chase is passed to a milling machine, which removes from the sides and outer edges the bulge of metal caused by forcing the joints together. It then goes to a special mortising machine, which squares the inner corners and rounds the outer ones. The accurate formation attained by this process is illustrated by an order of 200 chases, which were stacked

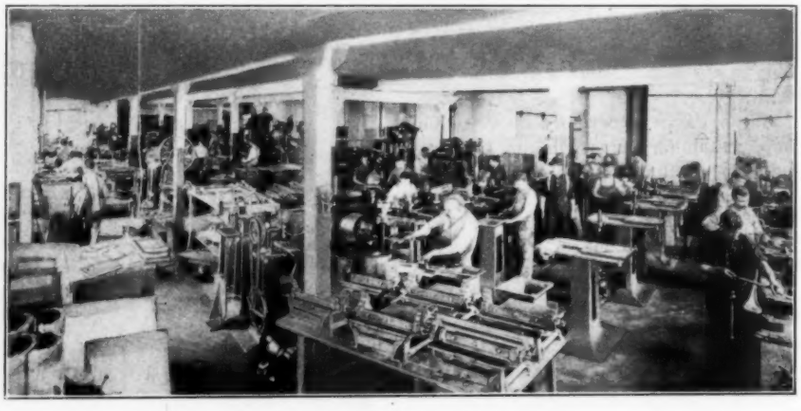


FIG. 7. ASSEMBLING DEPARTMENT.

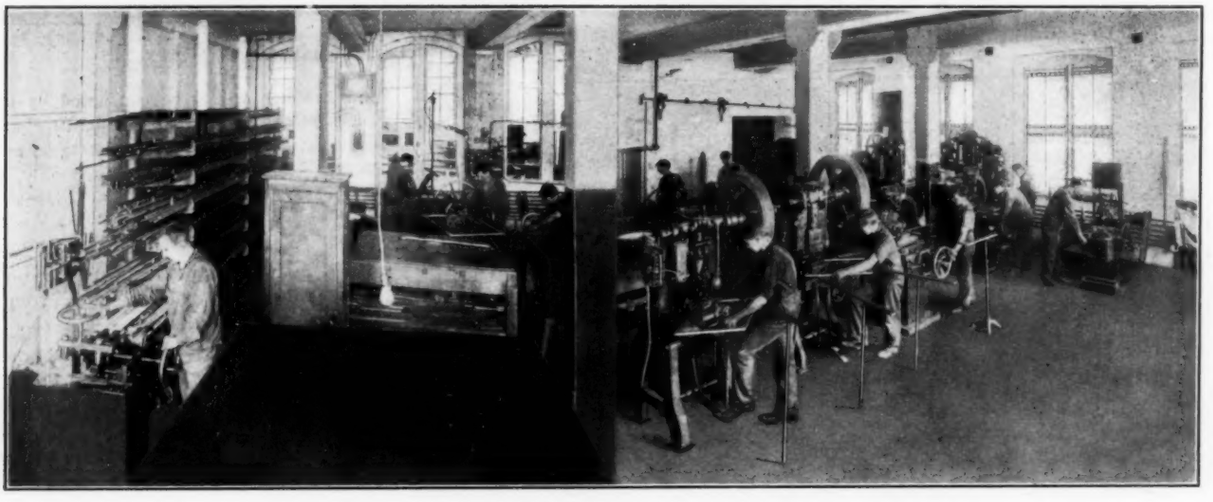


FIG. 8. ELECTRIC-WELDED CHASE DEPARTMENT.

one above another when completed, and the inside walls of the piles were quite plumb, square and true.

The pictures of the planer department on this same floor, Figs. 2 and 3, give a good idea of the manner in which the planers were equipped for application of the electric motors. The latter also shows one of the arc lamps which are employed for illuminating some of the shops, the objectionable direct glare of the light being avoided by shielding the lamp with a cone beneath it, as shown, throwing the light up against the reflector or diffuser, which spreads it around the room.

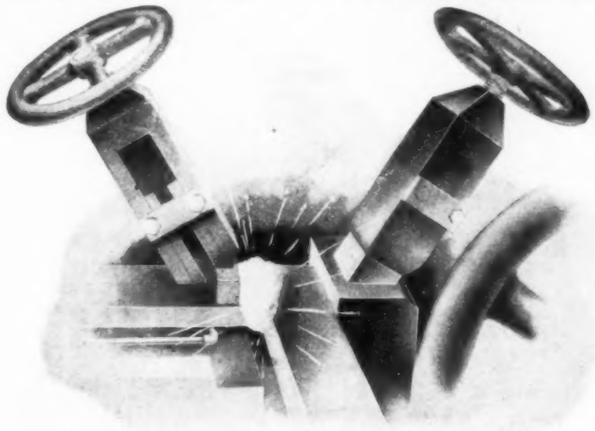


FIG. 9. WELDING A CHASE BY ELECTRICITY.

Fig. 4 is a good illustration of the order and neatness which is characteristic of the establishment. It is a view in the factory stock-room, and shows some iron racks made by the company for holding small parts of machines, such as bolts, nuts, screws, rivets, washers, wrenches, springs, etc., each class and size of article having its own gray-iron box, neatly lettered to indicate what belongs in it, and easily removable from the gray-iron housings or frames of the rack. There are in each rack two rows of pans, reached from opposite sides; the spaces between the pans and also that at the top of the rack are utilized for long rolled stock, tool steel, spring steel, etc., being reached from the ends. The pans are of very thin metal, so that there is no unnecessary weight to handle when it is desirable to take one out.

The picture of the show-room, Fig. 10, illustrates some of the machines built by the company. Each of these is, as already mentioned, provided with its own electric motor, connected up so that it is always ready for demonstration. The machine in the foreground is a jig-saw for making mortises in blocks carrying engravings; it has also combined with it a drill, and at the back of the table a sharpener for circular saws.

The machine next back of that one, and, in the illustration, directly below the mechanic by the switchboard, is a shear-cut shaver for book plates, which is of interest on account of the means employed to obtain a diagonal feed and shearing cut, so as to avoid buckling the plates in the thin portions. The knife can be seen carried in the head with the two thumb-screws above it, the cutting stroke being obtained by this knife-head traveling forward. At the same time the bed carrying the plate is moved at right angles to the motion of the knife head. Moreover, the stop against which the plate worked upon rests is at an angle to all the directions yet referred to, so as to avoid shaving the plate "head-on," with the resultant tendency to spring it.

FIG. 10. SHOW ROOM.

The machine next beyond this, partly obscured by the column, is a circular saw table for trimming wood or metal blocks.

The machine back in the room between the two men, in front of the large pilot-wheel, is a routing machine for stereotype plates, having a cutter or "bit" which rotates very rapidly about its vertical axis, and which, by means of the projecting handle, may be moved anywhere over the surface of the plate being worked upon, so as to rout out the portions of the plate which do not bear portions of the design.

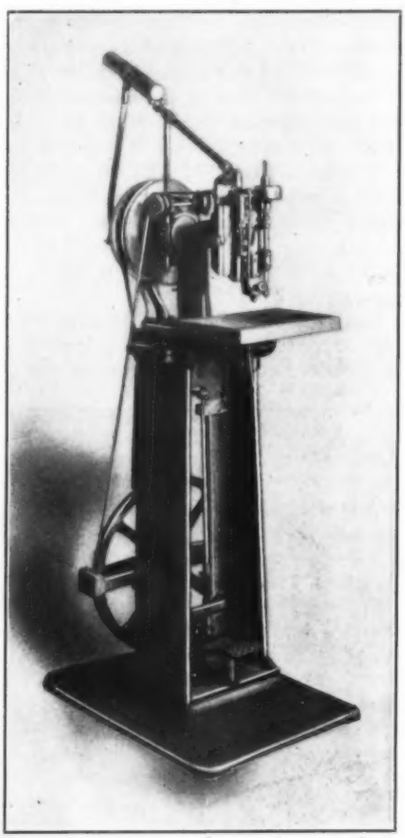


FIG. 11. NAILING MACHINE FOR ENGRAVERS.

There are many other machines for various purposes in the room, which are not seen in the illustration, or which do not show up well.

Fig. 11 is a view of one of these machines, which is of great value as a time-saver and insurer of neat work. It is for nailing metal printing plates upon wood or metal bases. The machine shown drills a hole through the engraver's copper or zinc plate and drives the nail. Fig. 12 is an illustration of the upper part of the machine. Fig. 13 represents the upper part of another similar machine, in which, however, the drill part is not included, as it is intended for electrotypers, and, the

nail being driven through a lead plate, drilling is not necessary.

Referring to Fig. 12, the work is, of course, placed on the table, the height of the latter being adjusted by the hand-wheel beneath it, so as to regulate the depth of drive. If desired, for nailing the edges of rabbeted or beveled plates, the table may be tilted. The nailer and drill are mounted side by side on a head which is capable of traveling horizontally an amount equal to the center distance between the two. When pressure is put upon the treadle (Fig. 11) by the foot, the clutch is released, and the drill comes rapidly down and returns, the head moves over, and down comes the nailer and pushes the nail home through the hole just made, whereupon the head returns to its normal position. This is all done in about a second. The nail magazine can be seen at the top and back of the machine, with the nails hanging, point down, by their heads. A jogging motion is imparted to this magazine, which causes the nails to slide in a continuous line down the inclined channel leading to the nailing mechanism. This machine will block plates as fast as three expert blockers working by hand.

Fig. 14 shows a machine of more general interest than the one just described. It is for the purpose of sharpening circular saws; its capacity being from 4 to 20 inches diameter of saw, and from 2 to 16 teeth to the inch, a 6-inch emery or carborundum grinding wheel being used. It is furnished for either belt drive or, as in the case of the one illustrated, with a ¼ horse-power electric motor. The saw is mounted in front of the lower portion of the machine; directly above it is the grinding wheel, supported on a pivoted arm and driven from the large pulley behind it, which in turn is driven from the motor above. At the back is a tool-grinding wheel and rest.

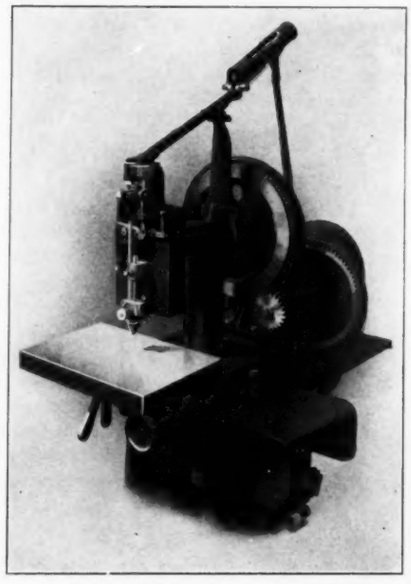


FIG. 13. HEAD OF BLOCK-NAILING MACHINE FOR ELECTROTYPERS.

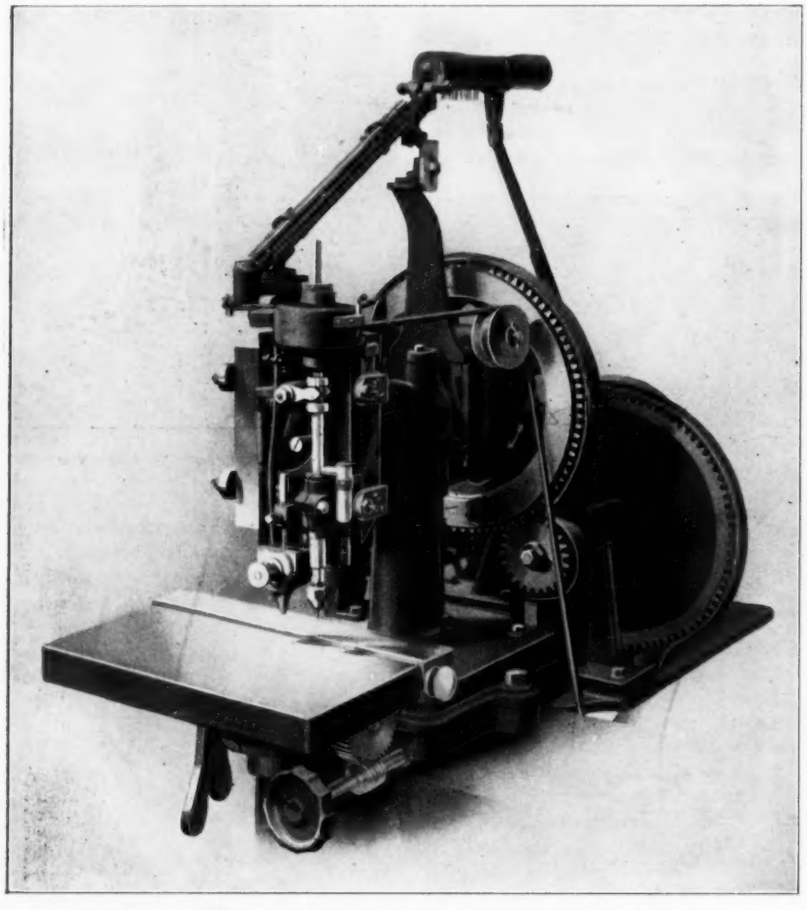


FIG. 12. HEAD OF BLOCK-NAILING MACHINE FOR PHOTO-ENGRAVERS.

The Liverpool Institute of Tropical Research, although its work is merely in the initial stage, has already justified its existence. It has solved a problem that was causing uneasiness in certain Lancashire mills. Wood, imported as African box-

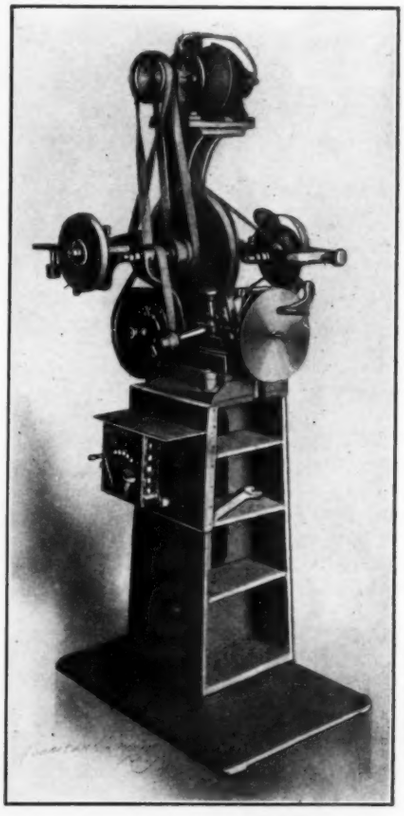


FIG. 14. AUTOMATIC SAW-SHARPENING MACHINE.

wood, had been used in the construction of new shuttles for these factories. Soon after the shuttles were put in use, a mysterious illness fell upon the operatives. Nothing like it was in the ken of the medical practitioners. Suspicion first fell upon one thing and then another, but examination proved the entire innocence of the supposed causes. At last the Liverpool Institute was communicated with. Experts in botany were brought to the examination of the mills, and then it was discovered that the shuttles were made, not of boxwood, but of another tree that contained an alkaloid of deadly import. Constant contact with this vegetable material had brought about the disease.—*The Indian Textile Journal.*

A New English Lathe.

The English lathe illustrated herewith is one which has been recently redesigned, and every part of which has been remodeled with a view to rapid handling and the convenience of the worker, the main feature of interest being the form of the bed, described further on.

The driving is by means of a special variable-speed motor, which is placed on a swing frame in the cabinet under the headstock; see Fig. 1. The armature shaft carries a 3½-inch pulley, which drives a 12-inch pulley on the main spindle of the lathe by means of a 3½-inch belt. In this way a direct belt drive from motor to spindle is obtained for the fast speeds, and advantage is thought to be gained in absence of vibration and smooth running for light work. As has been stated, the motor is placed on a swing frame, and thus the tension of the belt can be regulated without trouble. The spindle speeds are twelve in number, and for general work range from 18 to 300 revolutions a minute. A range of faster speeds can be easily obtained, however. The headstock is of box form and is completely covered. It is secured to the bed by means of four screws, which prevent lift or spring. When assembled, the spindle and gearing are balanced on knife-edges to secure steady running at the high speeds. Two gear ratios in the headstock are obtainable, namely, 8 to 1 and 9 to 1, and these are instantly available by means of change levers. Positive feed gear is also contained in the headstock, and all the feeds may be obtained without stopping the lathe. Drop worms control the surfacing and sliding motions, being actuated by triggers in front of the saddle apron.

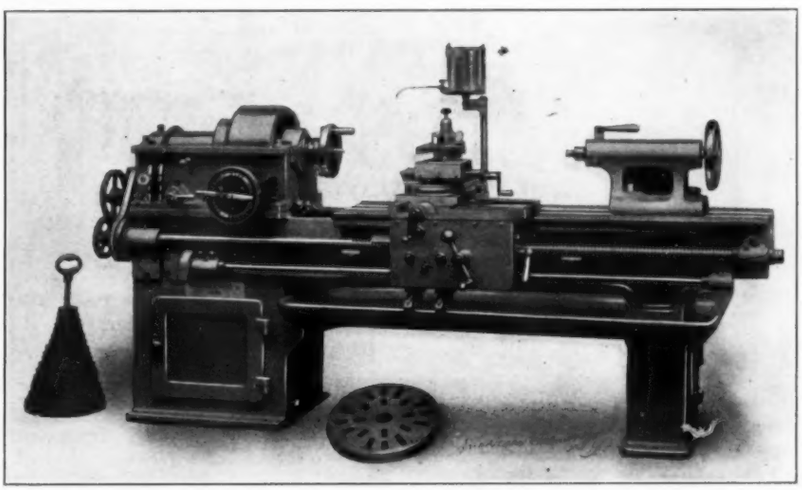


FIG. 1. A NEW ENGLISH LATHE.

The bed is of novel construction, and it is better illustrated in Fig. 2. Its section is deep to withstand the strain. The end which bears the headstock is carried direct on the cabinet which contains the motor. The other end has, cast solid with it, a short leg, which is borne by a smaller cabinet base. The chief interest in the design, however, lies in the form of the sliding surfaces of the bed. These, as usual in English practice, are flat. The saddle itself bears across the whole top surface of the bed, but it is guided by the narrow front surface only. A long, narrow bearing is thus provided, which gives an easy running slide. The central portion of the bed forms a support for the tool, and the surfaces at the back bear the tailstock. Finally, it will be noticed that the saddle can be brought well up under the tailstock.

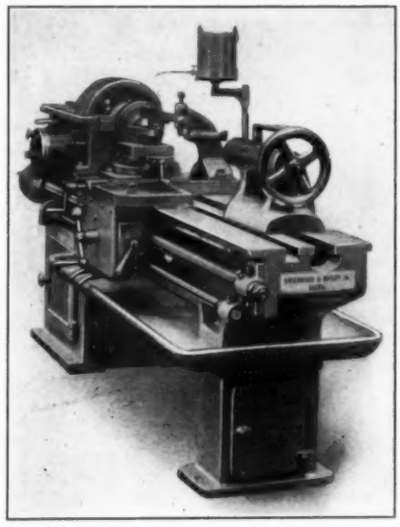


FIG. 2. A NEW ENGLISH LATHE.

The lathe is built by Greenwood & Batley, Ltd., Leeds, England.

"Did you ever notice," said the old codger, "how, when a man has made a fool of himself and suffered the natural consequences of his foolishness, he just about always finds somebody else to put the blame onto and makes a more foolish fool of himself by jawin' about that other feller?"

The Practical Man and the Technical Press.

It sometimes happens that some matter-of-fact person who is without any appreciation of anything that is not intensely practical finds fault with the technical press because, from his way of seeing things, it is not technical enough. This sort of a man is strictly utilitarian. He looks on the human element in the world as so many machines for grinding out work. Judging from observation, with him everything that does not fit into his peculiar methods of thought and of work are excrescences which should not be allowed, and if by any chance they should appear he considers that he is doing his fellow men a kindness in promptly trying to suppress them. A formula is his delight, as being the only proper way of expressing any technical information that can be expressed by one, and he is ready to take issue with the man who uses a figure or a letter unnecessarily even there. When the formula cannot be made to express the desired information it should then be put into some other condensed form.

There is a sort of food that is sometimes used for certain kinds of conditions. I am not sure of the proper designation for it, but I understand that it is composed of meat and vegetables which have been dried and pressed to such an extent that a few ounces contain all the chemical valuables which were in many pounds of the original substances in their natural form. This is the ideal of what the technical press should be to some people. It is well known that meat is a concentrated food, and that turnips, cabbage, beets, watermelons and most other vegetables are very bulky in proportion to the nourishment the scientific man finds in analyzing them. Perhaps it is a mistake, and some day some reformer will lead us from the error of our ways, but at present it must be admitted that most of us like to have a liberal quantity of vegetables along with our meat, and so far as I know the extremely compacted food is only used by those so situated that it is not possible to get any other kind. It is kept and only used in an emergency when no other kind is available.

To my mind this concentrated mixture well represents the formula. The meat might be said to be a representation of the strictly scientific article. The vegetables naturally stand for the literature which has not a very high scientific value, but which is consumed in large quantities because it tastes good, and makes people feel good after it is taken.

Wishing to pay the highest compliment I can to the technical press, I think of it as the mental eating houses of the people. Not hotels, understand me, but boarding houses. The hotels more nearly represent the book stores where you call for what you want, pay for what is furnished to

you, and, if your pocketbook will stand it, get the dyspepsia and such things.

If the boarding house is in the lumber woods it will set a different table from what one will, say in the center of New York; but in any case it furnishes food to suit the general run of people who board there. If it does not it loses its boarders. Even in the lumber woods men will leave one job and go to another because the board they have been getting is not to their taste.

There is one other peculiarity with boarders. The man who does the most kicking and growling is the dyspeptic, and the chances are that he is eating entirely too much meat and other concentrated food. When the man who fills up on vegetables is not suited he hunts another place and just quietly drops out, but the other fellow stays and kicks and sets up to represent the valuable part of the world.

Beyond the choice of the things that is furnished is the way they are prepared and served. Good cooking and nice, clean service is of the highest importance to most people, and there is no excuse for anything else that pretends to be fit for public patronage.

There are fads and fads, and the fellow with the fad is the kind of a fellow who will make the most noise. Here is a fellow who believes in taking his food raw. He wants all of his information in formula.

Here is the fellow who believes that the meat eaters rule the world, and that because some of the greatest of the world's workers are also great meat eaters, therefore everyone should stuff with meat. He would burden the weakling with the food of the giant, and wants every man to take a technical course whether he can digest it or not.

Here is the fellow who thinks the stomach should be saved from most of its work, and be fed with predigested food. He wants all information reduced to the kindergarten level.

And here, worst of all, is the fellow who thinks that what he does is the only thing and that all should be guided in their eating by his tastes. He is an insufferable boor in any boarding house, either mental or physical.

The wise boarder is a customer of the kind of a literary boarding house that most nearly supplies his wants as he sees them. He makes use of the articles which appeal to his taste, and leaves those that do not, and generally prefers the abundance of vegetables which are easily digested to the concentrated foods. It takes so much more care to properly consume the latter, and if carelessly done serious trouble is much more apt to follow than with the more bulky material.

Naturally, we expect the mass of articles in any trade paper to pertain to the things that interest the people of that trade, just as we expect the food of a country to be composed largely of the products of that country, but even here we find it is well not to be too narrow in the matter, for all sorts of tastes are to be satisfied.

What sort of things is it that the ordinary fellow remembers and remarks about? Is it the profound one that may really contain a germ that is to revolutionize the world? Question him closely and the chances are that he did not read the learned article at all, but he can tell you all about the device that was used to make some job a little easier or surer, or the way in which someone made an emergency repair under adverse circumstances. He understands the "roast" that some fellow gives to some sister trade, and is set to thinking by the one that is handed back in return.

The trade paper is something that is meant for regular use. It comes at intervals and sets up such a variety that we all can get something from it to suit our taste. It is not necessary to eat the entire bill of fare to get a fair return for our money, nor to read articles that are not interesting or profitable to us just because we have paid for the paper.

There is one thing that each one has a right to expect, and that is that everything is presented in a proper manner. Coarseness should not have a place in any literature, as it ranks with poor cooking.

I have gone somewhat out of my way to give my ideas on these matters, for the reason that I hear some of the talk that comes from the fellow who would "scientific" everything so that it was as dry as dust, and I don't want him to make so much noise that you may think he is everything. I do not want to miss my "vegetables" when I read *Wood Craft* even if I do wonder a bit what sort of a pattern-maker puts three legs on a long table such as Mr. Rowley shows. I give it credit for three. The one coming between the fitter's feet must be near the center on that side, and my imagination paints one at the far end of the right side. I cannot quite decide whether it is ornamentation or peculiar shadow that makes the streaks on the end. The patternmaker and the fitter are so true to nature that I know the other things must be, although I am not acquainted with that particular style of table.

Please, Mr. Editor, do not cut out the vegetables.—*"Practique," in Wood Craft.*

Logarithmic Charts.

BY E. G. ROBINSON.

In almost any line of mechanical work it frequently happens that a great many results are desired from a certain formula. Often the formula is a complicated one, so that the results are obtained only after the expenditure of considerable time. In such cases it is extremely desirable to resort to the use of logarithms, charts, or calculating machines. If a sufficient number of results are desired, it may lead to much saving in time to construct charts, even if involving no small labor. I recall one case where it was necessary to reduce a great many observations made on the flow of natural gas in pipe lines, the formula covering the case being quite intricate. In this case several days were spent in constructing a logarithmic computer, after which all of the observations were easily and quickly reduced, the whole thus resulting in a great saving of time.

A greater familiarity with the use of logarithmic scales would, no doubt, lead to a much more frequent use of dia-

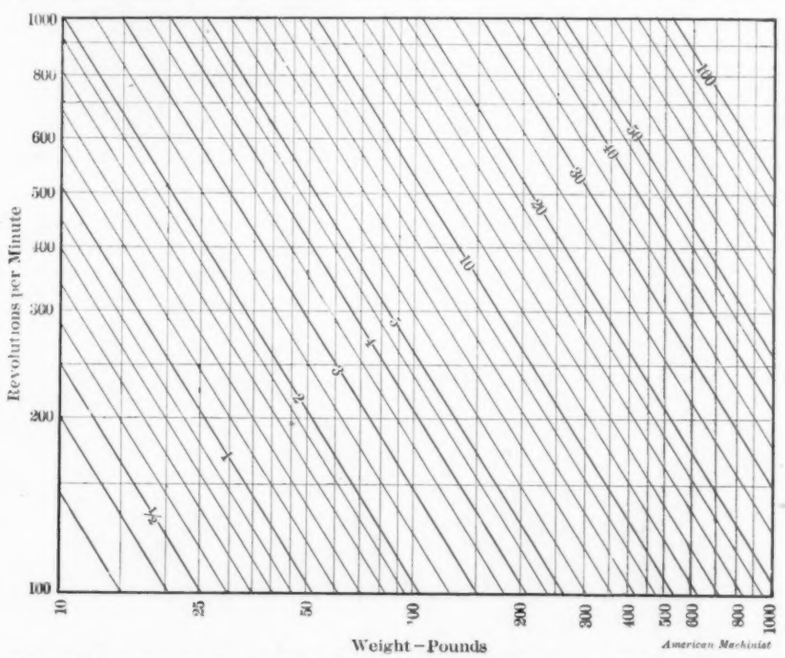


DIAGRAM FOR REDUCING BRAKE HORSE-POWER TESTS FOR BRAKE ARM OF ONE FOOT. FOR LONGER ARM MULTIPLY RESULTS BY LENGTH OF ARM. HORSE-POWERS INDICATED BY OBLIQUE LINES.

grams or charts; for, while the formulas covering most mechanical phenomena are of a nature to be shown on ordinary diagrams only by curved lines, thus requiring in their construction so much time as to be almost impracticable, yet these same formulas when expressed on logarithmic scales appear as straight and parallel lines and are thus very easily and quickly constructed. For, in such cases, it is necessary to locate only one point in each line, which can then be drawn, since the common inclination of all the lines is known from the nature of the formula.

As illustrating the preceding remarks, the accompanying chart may be of interest to some readers. It was made some time since to serve during a series of gasolene-engine brake tests. To be sure, in this case the formula is a simple one, being of the form

$$H.P. = C\,x\,y,$$

where x and y stand for *revolutions per minute* and *weight on scale* or *pressure at the end of brake arm*, C being a constant. Anyone attempting to plot this formula on the ordinary scale will become involved in considerable time-taking labor, and in the end will have produced a series of interesting hyperbolas which will serve the purpose no better than the chart here shown, which can easily be drawn in a very short time.

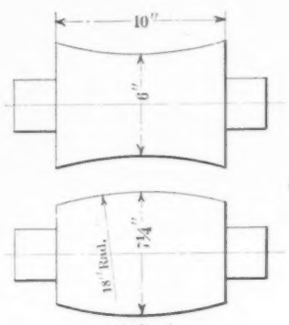


FIG. 1.
The Rolls to be Machined.

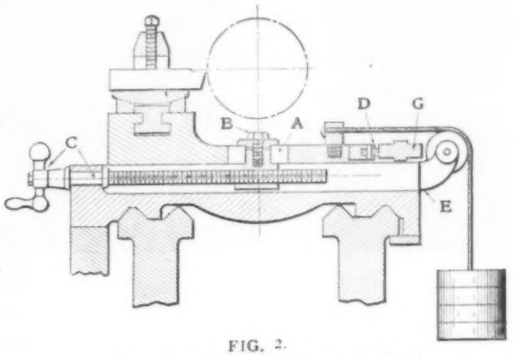


FIG. 2.
Section through Slide with Former in Position.

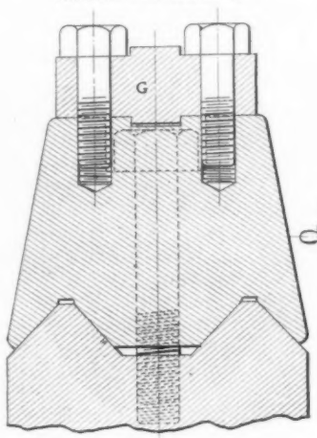


FIG. 4.
Section through Bracket, showing how the Former is Fastened to the Bed.

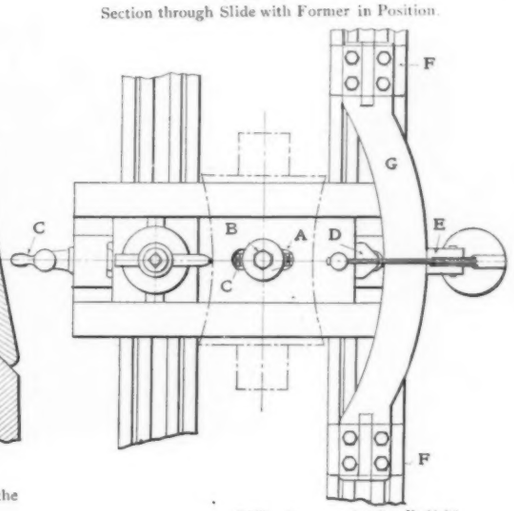


FIG. 3.
Plan of Slide with Former in Position.

A Turning Attachment For Curved Profiles.

A short time ago I had occasion to use a special turning attachment of which I send sketches and particulars. I am foreman over a small engineering shop, of which the tools are all very ancient. One day a blueprint similar to Fig. 1 was brought to me, with orders to make a lot of rolls to the figures shown. Choosing the most modern lathe, I examined it with a view to finding out to what extent it could be altered. I removed the nut which was fixed to the under side of the top carriage slide and which was actuated by the screw C, and replaced it with a loose nut working in a slot, as shown at A, Figs. 2 and 3, so made that by tightening up the hexagon head of the screw B the slide could be worked in the ordinary way by the handle and screw. I made a bracket D to carry a steel roller, and fixed it to the end of the top slide. This roller was to run against the edge of the former G when the slide was free to move independent of the screw. A stud was screwed into the top slide and a piece of 3-16 inch wire rope was fastened to this stud and carried over a guide pulley fitted to the back of the saddle at E and some weights were attached to the end. The former was then made with one edge the same shape as the convex roll and the other edge to suit the concave roll. The top and bottom faces of the casting were machined with a tenon at each end. The edges of the former were filed up smooth without altering the shape. The brackets were bolted firmly to the bed, as shown in Fig. 4. Each of these brackets had a groove machined in it, to suit the tenon on the ends of the former. This tenon located the former in a central position, and when it was turned upside down to use the opposite edge there was no doubt about its being located in the same position as for the first side. The forgings of the rolls were somewhere near the shape they were to be when finished and when put in the lathe, the screw B, Fig. 2, was tightened up and the forging roughed out to something near the size and shape, using the feed of the saddle and working the cross-slide with the handle. The screw was then released and the slide was free to work from the former, the weights keeping the roller well against its edge.

By altering the shape of the former, any number of different jobs could be done with this attachment at a much cheaper price than without it. Of course if I were designing a new lathe to have an attachment like this, I should improve on the details very much. The sketches only show the cheapest way of making it.

THE FOREMAN.

Who Will be Hurt?

A good case of looking a little below the surface of things, in a very wholesome and instructive way, is found in a recent issue of the *Saturday Evening Post*, which publishes, under the title given above, the following:

Probably the able president of the Great Northern has been misquoted. Press despatches make him say that if the Interstate Commerce Commission is given the initiative in regulating freight rates the "country will be strewn with railroad corpses."

Mr. Hill is intimately acquainted with the physiology of railroads and he knows that, as a matter of fact, they never die. For all temporal purposes they are immortal. Various things may happen to the men who own them. Over-enthusiasm on the part of the management in the matter of issuing bonds may result in receiverships and reorganizations; but the railroad itself never misses a heart-beat. The tracks are there. The trains run. Persons and goods are moved just as before. Mr. Hill will recall that he earnestly assisted in giving the Burlington road, to a superficial view, a highly dropsical appearance—by boosting its stock to $200 a share and capitalizing it in bonds at that figure. Yet the road was really as healthy as ever, and was able last year to move over 20,000,000 tons of freight. If the Interstate Commerce Commission should take to slashing freight rates, Mr. Hill might personally be strewn with a large amount of depreciated Great Northern

stock; but the railroad that he built would never know the difference. His dividends might be only 5 per cent. instead of 7, and he would, perhaps, be unable to issue to stockholders at $100 a share $25,000,000 of new stock worth $300 a share in the market, as he has just had the pleasure of doing. But not a rail would come up, nor a tie fall out, nor an engine-wheel turn the less briskly. If the Great Northern had raised that $25,000,000 by issuing stock at its market value of about $300 a share, the dividend requirement would have been less by more than $1,000,000 a year, and $1,000,000 a year would give an appreciable reduction in freight rates.

A man of Mr. Hill's eminence must not be encouraged to depress the public with funeral prospects. He must look on the bright side.

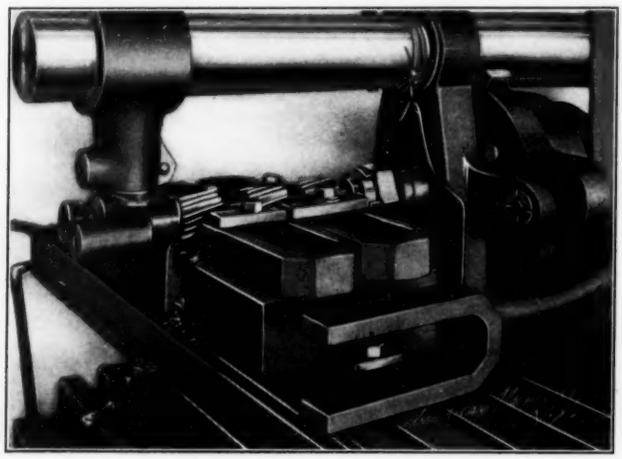


FIG. 1.

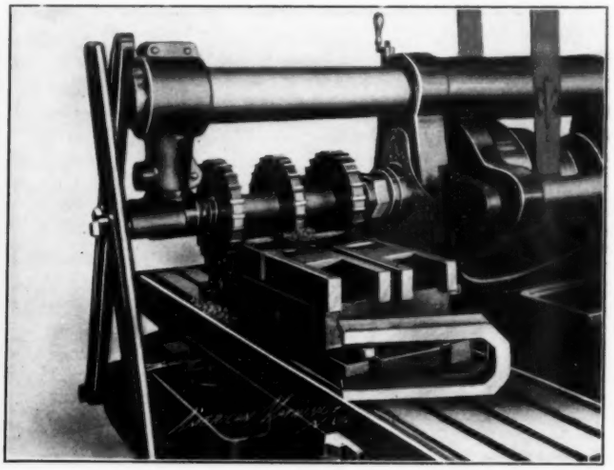


FIG. 2.

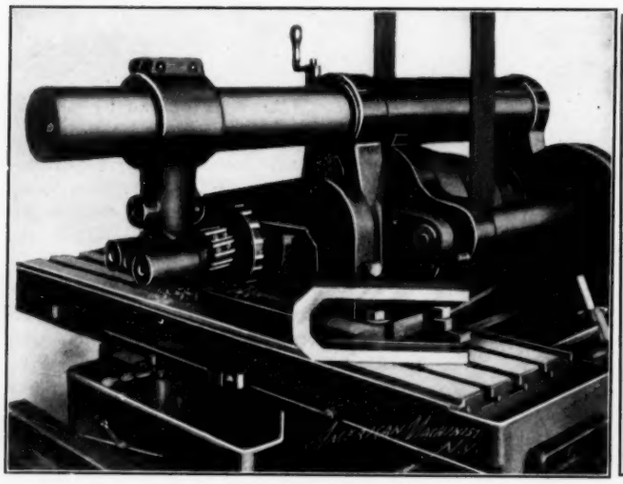


FIG. 3.

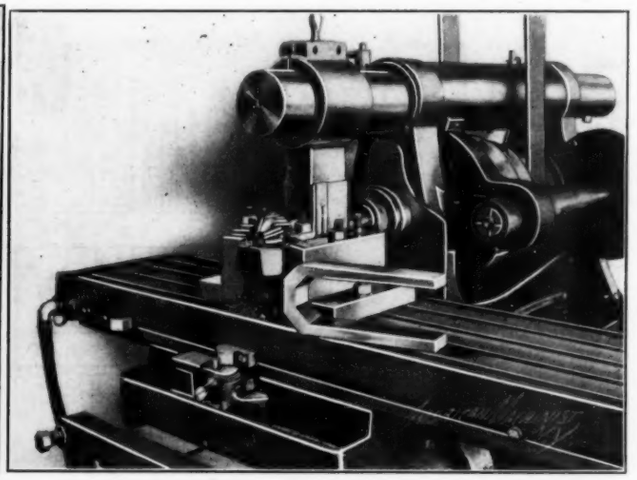


FIG. 4.

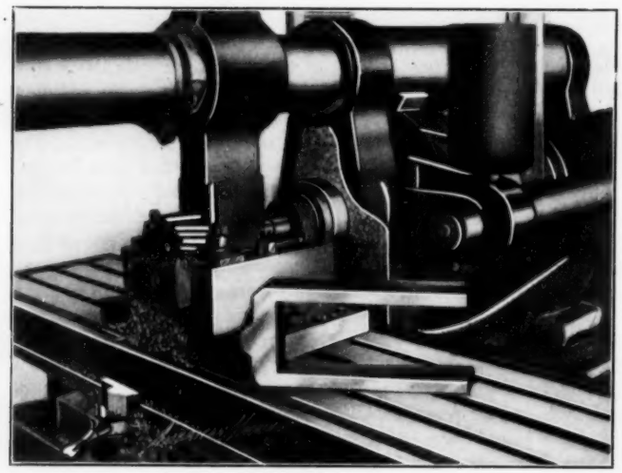


FIG. 5.

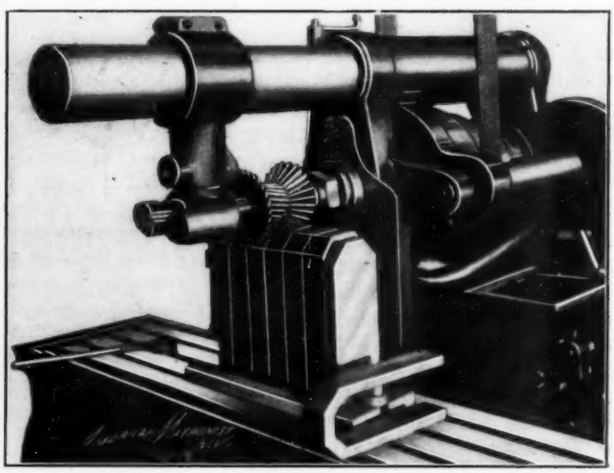


FIG. 6.

MILLING CONNECTING-ROD STRAPS.

Some Milling Operations.

EDITORIAL CORRESPONDENCE.

The Frick Company, of Waynesboro, Pa., is engaged, among other things, in the wholesale manufacture of agricultural engines, and the extent to which systematic methods have been applied to its products may be judged by the accompanying illustrations of the methods used in making the strap ends of connecting rods.

The illustrations are almost self-explanatory, but it may be remarked that they show by their numbers the regular sequence of operations. In Fig. 1 the ends of the freshly forged straps are being squared up; in Fig. 2 the external top and bottom surfaces are being milled; in Fig. 3 the interior top and bottom surfaces and the sides are being surfaced; in Figs. 4 and 5 the end of the interior in two pat-

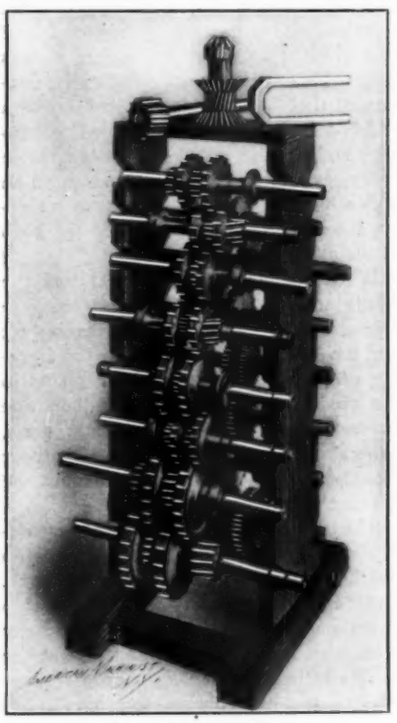


FIG. 7. A RACK OF MILLS.

terns is being milled, and in Fig. 6 the strap, except for the gib and key holes, is being finally finished by a cut across its end. It will be observed that in several cases the fixture accommodates four straps.

I have seldom seen a shop doing work of the size here done, in which milling has become the matter of course method of surfacing parts to the extent that it has here. Rack after rack of gang mills, all mounted on permanent arbors, are to be seen, and of them Fig. 7 is a sample. Most of these mills, together with some of those shown in the preceding illustrations, will be seen to have inserted teeth, and these, in all cases, are of high-speed steel. The teeth are inserted in the simplest possible manner, being driven to place without keepers of any kind. F. A. H.

College Shop Experience—VIII.

BY HARRY MARQUETTE.

When the heating plant at the college was designed, a battery of boilers was installed, composed of one Sterling boiler, one Babcock & Wilcox and two ordinary return-tubular boilers.

Ordinarily the Sterling boiler was used for furnishing power for the electric-light plant, and the other boilers for heating the buildings. A pipe was carried up the hall, and the reducing valves placed at each building.

Ninety pounds steam pressure was carried on the main line, which was reduced to eight pounds in the buildings. The drip was brought back through a separate pipe system. The pipe-line had been calculated quite closely for carrying the proper number of heat units in steam at 90 pounds pressure.

There had been no trouble in heating the buildings, but the Board of Regents had kicked on the fuel bills, and hence when "His Nibs" took charge he announced that he would cut those bills in two in the middle. "Nobody but a blamed fool would burn the quantity of wood that had been burned the previous winter." He proceeded to examine the system and make a written report to the President and Board, in which he scored the designer of that system in no uncertain terms. Some of the statements made in the report were as follows:

"Any engineer who has had any experience whatever would know better than to raise that steam to 90 pounds pressure and then drop it to 8 pounds pressure. You can see that that is a drop to less than 1-10 of the boiler pressure, and that it is just a waste of the extra heat required to force that steam up to the high pressure. What you want to do is to jerk out all those reducing valves and carry about 10 or 12 pounds pressure at the boiler. This will give 8 or 10 pounds pressure at the buildings, and we will cut out the tremendous loss of boosting that steam to 90 pounds pressure and then dropping it again before we use it."

This talk sounded good to the cattle king, the prince of sheep herders, the Squaw Gulch miner, the city merchant and the lumberman, who composed the Board of Regents, the sum total of whose knowledge of the theory of steam heating was rather less than that of a year-old baby on the subject of parliamentary law. They patted "His Nibs" on the back and told him to go ahead; he was the man for them. So they cut the contracts for wood one-half, and jerked out the reducing valves.

The fall was an unusually mild one, and everything went well until Thanksgiving time, and "His Nibs" was getting more cocky every day over the immense saving he was going to make and still efficiently heat the buildings.

School closed on Wednesday noon to give the students a short holiday, and as there was no special work to be done in the shop, the "Prof" decided to spend his spare time during vacation in working up his lecture notes at home, and so he adjusted the valves supplying steam to the shops in such a way that the drip valve was wide open and the steam valve partially closed, permitting just sufficient steam to flow through to keep the building from freezing.

In order to make sure that everything would go well, he called "Red Frank" over to the man-hole where the valves were situated, showed him how they were adjusted and told him that if it got colder he was to open the steam valve a little more.

About 4 o'clock in the afternoon, with practically no warning, like some fierce bird of prey, a storm dropped from the mountains into the valley and sent the mercury far below zero, filling the air with a blinding, whirling mass of snow, traveling 25 or 30 miles an hour. The "Prof" immediately donned his clothes and started up the hill to buck against the storm and put more steam onto the shops, but just before reaching the plant he encountered "His Nibs."

"Where are you going?" he demanded.

The "Prof" replied that he was going to turn more steam onto the shops.

"There's no need of your going up," said "His Nibs," with his customary air of having closed the discussion. "I just met 'Red Frank' at the man-hole and I fixed it myself."

Fortunately for after developments, the two firemen overheard the conversation, and hence "His Nibs" could never back down from his statements, however much he might have wished to do so. As "His Nibs" had also requested the "Prof" to go over to his house to look after some matters for him, the two men went across the valley, and it was Sunday evening before the "Prof" again visited the shops. Breaking through a drift five feet high, he reached the door and entered. It was a toss-up which side of the door it was colder—inside or out. An investigation showed that there was absolutely no steam in the building, and that apparently everything carrying steam or water in the building was frozen tight. Going to the man-hole to investigate matters, the "Prof" met "Red Frank" and also discovered that the drip valve was closed off tight and the steam valve wide open—the reverse of the conditions he had expected to find. Impulsively he demanded,

"Well, were you drunk or crazy to leave those valves in that condition?"

"Not guilty of either; just let 'His Nibs' alone, that's all. I guess he's burned his fingers plenty this time," observed the engineer.

Coming to inquire into the matter, it developed that on the day the storm started "Red Frank" was in the act of turning more steam into the building when "His Nibs" came along, asked how the

valves were left, and said, "Any fool would know better than that. I will show you how those valves should be fixed," and taking the valve-key, he shut off the drip and opened the steam valve as wide as he could. "There, now, do you see?" he said. "You will get every bit of good there is in that steam, for the hot water will stay there and help keep the building warm, and at the same time you will be saving steam. For the length of time the building will be shut up it will be just as warm as an oven."

"Red Frank" remonstrated, but received such a sharp rebuke that, as he expressed it, "he thought he'd let the fool burn his fingers."

An investigation showed that the extent of "His Nibs'" burn was considerable, as the steam pipes and water pipes had burst in forty or fifty places, and it took the "Prof" and several boys the better part of a week to get them thawed out and into shape once more. To make things more interesting, once the thermometer got below zero it seemed to forget to come back, and that short-ration wood-pile melted away like snow before a steam jet.

Realizing that something must be done to save his reputation, "His Nibs" began to hunt for some way out of the difficulty. The solution which he, with the President back of him, carried into effect, was to close the museum, drain the pipes, and let it freeze up for the winter. By a little crowding they managed to let two or three of the recitation rooms share the same fate, but still the wood continued to vanish too rapidly. One morning the "Prof" found a note on his desk setting forth these statements: "Your boys don't need heat; if they work lively they can keep warm. I have had the unions in the man-hole leading to the shop taken off, and the pipes capped, and we won't use any steam in there this winter."

Fortunately, this ultimatum came in a mild spell, just after the holidays—in fact, in the January thaw. But the "Prof" had had some experience in those mountains the winter before, and knew that in that country the weather generally had the last word, so he changed all his shop plans in a hurry.

In the first place, several large stoves were rustled up and placed in the part of the shop where work would be carried on. The work was rearranged so as to manage to get along without the use of all the rooms. Opposite each one of the stoves a pane of glass was taken from the upper part of the window, the stovepipe run out through the opening and supported by a wooden frame and a sheet-iron collar. Then, in place of securing a stock of planed lumber for the wood-working exercises and the patternmaking, rough planking and 2x4's were secured from the stock of a bankrupt sawmill; this having been bought in by the sawmill for which the "Prof" had been doing work.

The aforesaid bankrupt sawmill had evidently had a farmer for a sawyer; some of those 2x4's were 1¾x5 inches at one end and 3x4½ at the other. A good many of them were large in the middle, and small at both ends. All of this crooked stuff necessitated considerable machine work to get it into proper form for the work to be carried on, and the waste from the machine work furnished a large amount of sawdust, planing-mill chips, edgings, etc.

Arrangement was also made with one of the departments to furnish it with a full set of tables, and the getting of these tables out of the rough stock mentioned formed some of the advanced wood-working exercises. The turning classes were also kept busy during this period and the turning chips helped out in the stoves. Permission was given to any of the boys who wished, to make tables, cupboards, or other furniture for their rooms, providing work was carried on outside of their class hours, and the chips and blocks from these were allowed to go into the stoves.

This change in the program had the effect of introducing a large amount of machine work into the wood-working exercises, which proved to be very beneficial to the boys in the knowledge gained in their craft, and the not unimportant circumstance that the temperature of the shop was kept above freezing by burning the chips and blocks therefrom. The supply of fuel was still further augmented by begging wagon loads of barrels and boxes from the merchants in town, and persuading one of the college teamsters to bring them up a few at a time as he had opportunity, in connection with his regular work. These various schemes and devices enabled the "Prof" to escape in some measure the trouble which the rest of the faculty were experiencing from the economical system of steam heat introduced by "His Nibs."

The Board of Regents did not meet during the cold weather, and one of the professors decided that it would be a good thing to have a record of affairs, and hence kept a thermometer hanging in his classroom, which was read every hour and a record kept. His method of keeping the record was to call the roll, mark the attendance, step over and read the thermometer to the class, and enter it in a column which he had provided in his record book. In this way the entire class were taken in on the matter, and could verify the temperature at any time.

In exceedingly cold weather low-pressure steam will travel only a certain distance in a pipe before it becomes frozen, and the rate of flow naturally bears a distinct relation to the difference in pressure at the two ends of the line. The college greenhouses were located between 1,500 and 2,000 feet from the boiler-house, and every other building received steam before the greenhouses. The result was that late in February, when there was a tremendous blizzard and the boys at the power-house had run the steam pressure up to over 20 pounds in an attempt to keep the buildings warm, the low-pressure steam failed to reach the greenhouse in sufficient quantity, and most of the pipes froze, to say nothing of what happened to the flowers and plants with which the professor of botany and those in charge of allied departments were carrying on a very important series of experiments.

The freezing of the greenhouse brought down so much wrath on the head of "His Nibs" that he arranged to have installed in an out-building belonging to the greenhouse a small portable boiler belonging to the engine used for power purposes on the farm in the summer, and arranged it to supply steam for the greenhouse; but this necessitated the hiring of an extra fireman upon cold nights, when it was feared the greenhouse might freeze. Despite all of the efforts to cut fuel bills, the freezing of the faculty, greenhouse, and everything else about the place, it was impossible to prevent the rapid extermination of that small wood-pile, and hence a supply of coal had to be secured to help out; and anyone who has had experience in firing a mixture of coal and wood in boilers fitted up for wood firing, can appreciate something of the troubles the boys at the plant had.

When the winter was passed and the whole story told, it was found that the saving in fuel had not been so excessive; and when the losses incurred by the freezing of pipes, destruction of the plants in the greenhouse, damage of buildings due to freezing and bursting of water pipes, general crippling of work due to improper heating, and all, were charged against the "saving," there was nothing left.

The next year the running of the steam-heating system was quietly turned over to another man, the reducing-valves put back, and "His Nibs" given other matters to experiment on. But to the end he stoutly contended that he was right and that the failure to heat the buildings properly was due to the exceedingly poor quality of wood and coal which were used, and to the fact that it was an exceedingly windy, cold winter.

From Chicago comes an indictment against the pneumatic tools that are used in constructing steel-frame buildings. It is declared that a number of people have had their eyes seriously injured by small particles of steel which are detached by these tools and sent floating through the atmosphere. These are said to have been found imbedded in the eyes of patients who had no suspicion of the cause of the trouble, and they are reported to have seriously injured the eyesight of a number of horses as well. Naturally, we suppose, a person injured would have a remedy if he could prove that the particular piece of steel came from a certain hammer.

Automobile Construction—I.

BY F. C. MASON.

A great many mechanics like myself cherish the desire to own an automobile, yet are not situated pecuniarily to gratify their desire, and I also believe that quite generally they are not conversant enough with the construction to go ahead and build a successful machine, providing they had the facilities at hand.

In this series will be described a light gasolene touring car, which I am building myself, and later will be given a description and detail of a runabout which will be cheap and easy to build, and suitable for those who do not desire as pretentious a car as the former.

Figs. 1 and 2 show a side elevation of the car and plan of chassis respectively. In the drawings no attempt has been made to show every nut, bolt and rivet, but rather the idea has been to give a concise illustration of the affair that will not be confusing to the reader. The principal parts in the chassis drawing are named instead of being referred to by number or letter. The collective parts of this machine are of a standard type, and have been thoroughly tried out. The engine is a double-opposed type of 10 horse-power, with cylinders of 4-inch bore by 4-inch stroke.

In most light touring cars of a moderate price the wheel base is not over 76 or 80 inches. In this machine a 90-inch base and 32-inch wheels are called for. It is optional with the builder whether he makes it 90 or shorter, and with smaller wheels, but I strongly recommend the longer base and wheels larger than the standard 28 inches, for easy riding qualities.

In the drawings a pressed-steel frame is shown. The builder would have to buy this style of frame, but if he does not care to go to that expense (about $60) he may substitute an angle-iron frame, which will answer the purpose as well, barring appearance and lightness. No distance (brace) rods from the rear axle to the frame are shown as in the usual practice; with the type of spring illustrated they are not needed, as has been demonstrated in this city.

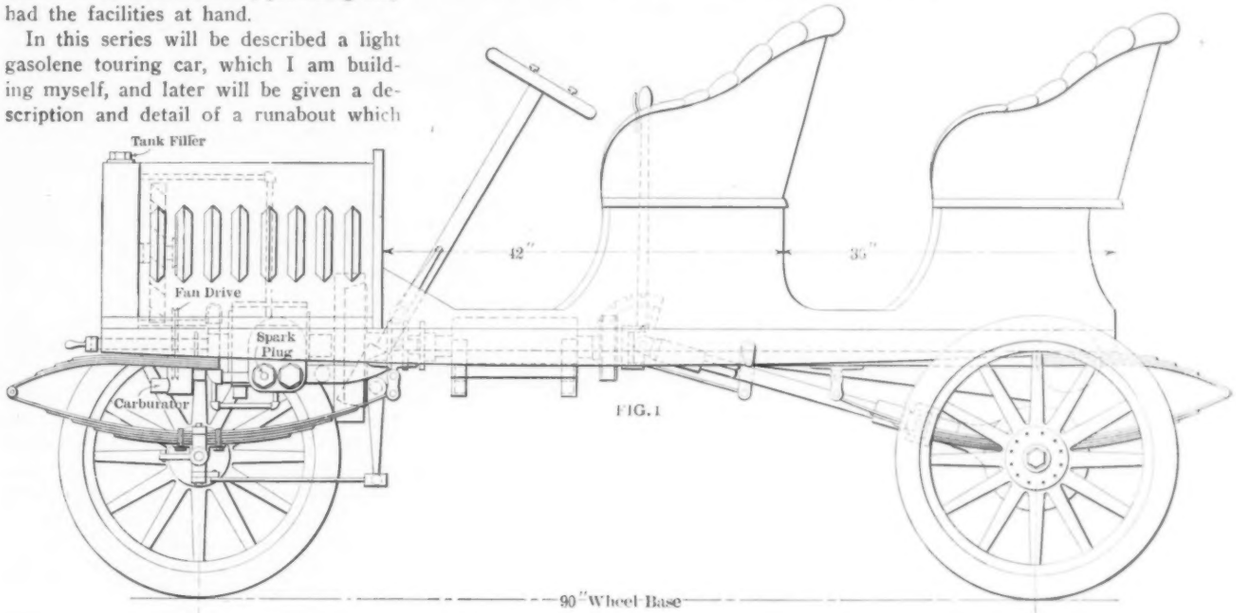


FIG. 1

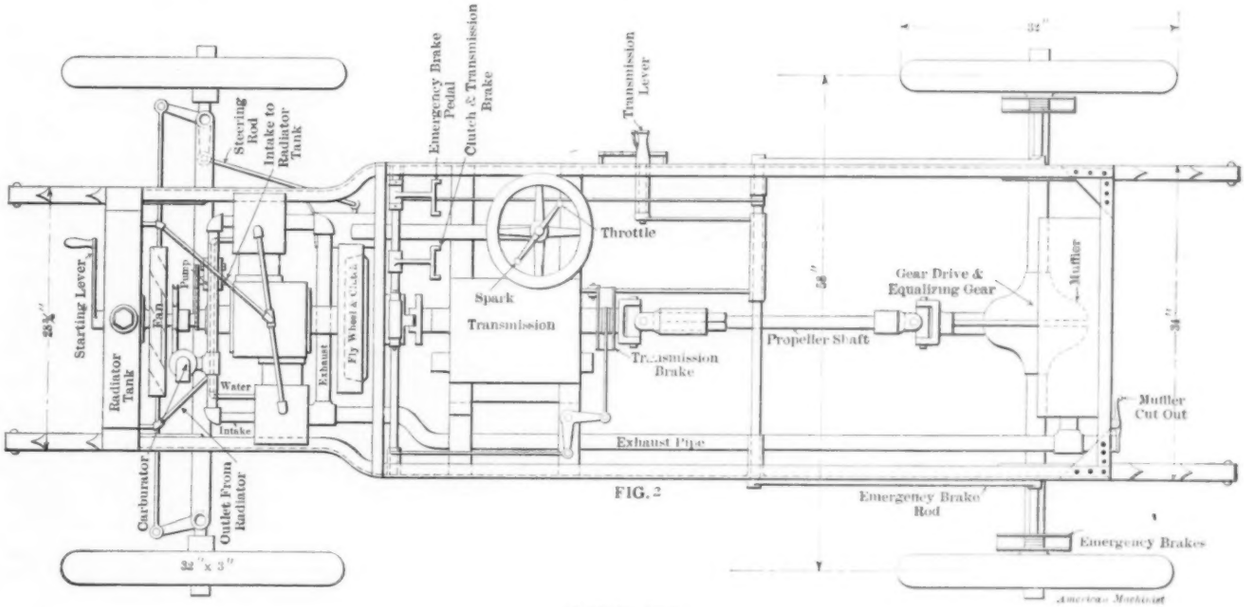


FIG. 2

TOURING CAR.

The body is of the open surrey type, with side entrance without doors. Doors add somewhat to the appearance, but for convenience I should prefer them off, and it simplifies the making a great deal.

For steering gear will be shown a higher type of gear than is usually put on a moderate-price car. The throttle and spark-timer lever work from telescopic tubes through the steering-gear wheel

shaft. It takes a little longer to make, but is well worth the trouble.

The drawings of the chassis do not show the connections from the time and throttle levers to the commutator and carbureter as they would be underneath, making it difficult to show them in a clear manner. They will, however, be brought out in a later article.

The transmission is of the sliding-gear type, three speeds ahead and reverse, which is recognized as a satisfactory all-around transmission. The planetary type has its supporters, and is used on this type of car; but of the two, I prefer the gear-box. The rear axle is of the bevel-gear-drive equalizing type.

In the water-circulating system for cooling the engine cylinders, the piping is shown as clearly as possible without another projection. The pump is fastened to the engine, and is of the double-gear type, driven by chain and sprocket from the engine shaft. The outlet pipe from the pump leads to each cylinder, entering the water jacket near the valves; the outlet from the cylinder is on the opposite side and leads to the radiator tank. The water flows from that tank into the radiator, circulates through the radiator and is taken out at the bottom and returned to the pump suction, and the cycle is repeated.

The location of the gasolene supply is not shown in the drawing. This is usually put under the front seat and piped to the carbureter. The tank should be of copper and well made to insure no leakage, as leakage is extremely dangerous. The piping should be of annealed copper tubing, fitted with ground-joint unions.

In the articles to follow, details and explanations of all the principal parts of the machine will be given; also the method of wiring up the ignition equipment.

Whenever mining matters are discussed in Parliament there is sure to be sympathy for those who spend so much of their time below ground. Yet nobody, says a London correspondent of the *Citizen*, seems to think of poor Londoners. For many years past millions of journeys have had to be made through tunnels that reeked like the infernal regions with smoke,. steam and sulphur fumes. We already possess several undertakings in which passengers are carried for miles through holes of 11 to 12 feet diameter, and additional borings are now being made in a dozen other directions.

One of the oddities of our nomenclature is that the combination of metals known as german silver contains no silver in its composition and is of Chinese and not of German origin. It was first introduced into Europe by the Germans, and for some time it was not generally known that they had simply borrowed it from the Chinese.

Letters to the Editor.

Following up Inquiries.

Having occasion recently to get up cost schedules and estimates on shop equipment for an organized concern about to establish its own plant, I have been struck with the different manner in which different, and often competing, firms handle the same inquiry.

It is frequently said, and with a considerable degree of truth, that anything can be sold nowadays by advertising, but I am inclined to believe that a good many advertisers overlook the fact that the function of the advertisement, as applied to standard and competitive articles of large cost, is not to sell goods out of hand, so to speak, as with soap or candy, but to interest the buyer and put him in touch with the advertiser, giving the latter the chance to strengthen his position and claims at closer range and to elaborate on the superior merits of his wares.

Practically, all of the forty or fifty firms to whom I wrote in this instance are advertisers in the AMERICAN MACHINIST; so it would be safe to assume my position to be that of the average genuinely interested inquirer from whom direct replies from such advertising are looked for. In my letters, which were substantially the same in each case, I stated the necessary facts as to the work to be done and the nature of the equipment, asking for net quotations on such machines of each make as, by experience, I was partial to and most interested in, and ending with the suggestion that as the manufacturing to be done was one in which considerable special machinery is usually employed, I would be glad to consider any special recommendations as to anything in their line which they might suggest.

So much for the inquiry. Every salesman, whether of machinery or supplies or tooth-picks, knows that two-thirds of the chance of a sale depends on the way an inquiry is followed up. How were these followed up? Let me give a few instances.

One well-known firm, making a complete line of machine tools, replied with a single-sheet circular of a six-hundred dollar machine about which I had inquired. They did not otherwise acknowledge my letter, did not quote price as asked, and made no effort to get the business or to see if there was any opening for their other tools. This machine we had to have, and it stands on the completed list; but it is a solitaire, so far as that firm is concerned, whereas it is not impossible that it might not feel so lonely when it gets in the shop.

Three firms failed to reply in any way.

At least a dozen sent circulars or catalogues and the usual perfunctory letter: "We enclose, etc., as requested. Hoping to be favored with your order, etc."

In fully sixty per cent. of the replies, this perfunctory, lack-luster, send-the-d—n-people-a-catalogue spirit is overwhelmingly in evidence. It is only too plain that this answering of inquiries is a nuisance and a bore, and not at all the golden privilege which they have so sedulously sought by means of advertising, which has cost good money. Doubtless "advertising doesn't pay" with some of them.

Of two supply houses right in New York city, one disgusted me by its persistent efforts to *sell* me a catalogue, and the other wrote a very polite letter and sent a complete catalogue of their *blacksmith's* tools, when the inquiry had stated that we were only interested in tools and supplies applicable to a certain line of very delicate work, comparable with instrument making. Needless to say, the small-tool and supply [illegible] gone elsewhere. Several machine firms "r[illegible]d the matter to their agents," but in two instances the agents failed to connect.

After a couple of weeks of this sort of thing I wrote, just for curiosity, to a large New England firm, taking pains to make it clear in my letter what we might be in the market for, and winding up with a request for circulars of a tool-holder of their make. They put out a line of automatic machines which are right in line with the inquiry, and yet all they did was to send the circular requested. Is this good business? Why do they advertise their machines? Certainly to attract business, and yet they pass over an inquiry of this sort.

To look at the other side of the shield, I can name a dozen representative firms whose letters were a pleasure to read—inquiries carefully answered in detail, suggestions and recommendations intelligently made, prices and capacities given. Two or three asked me to visit their works at their expense (which, of course, I did not do), in order to decide certain points or see special machines in operation, while under all was that courteous we-want-your-business-if-we-can-get-it-honestly air which, when backed up by "the goods," goes a long way toward establishing pleasant relations between buyer and seller. Nearly everyone is amenable to consideration and courtesy.

My lists are completed and my estimates ready; naturally there were some tools which would have gone in under any circumstances, but I leave it to the reader to surmise which firms got the most business, quality and price being equal on certain standard tools.

I have no complaint to make—no grievance whatever—and I say this lest some should misinterpret the tenor of this communication. The conditions here related are not novel nor at all peculiar to the machine trade; but they are ones which every advertiser ought to consider in relation to his own office, and this is my object in stating them. I think that it will always be found to pay to follow up in the right way—a little tact, a little

horse sense, a good deal of business insight and a dash of courtesy, the latter unnecessary perhaps, but serving to give the whole an agreeable flavor to the consumer. It should be borne in mind, however, that courteous attention is one thing and blatant insistence another. It does more harm than good for a salesman, just to "get ahead of the other fellows," to run you to earth at your house after a busy day, in which you could not see him at the office. Yet this has happened before now.

A large proportion of all inquiries must, in the nature of things, fail to yield results, no matter how they are followed up, just as a certain percentage of accounts are always bad, however careful one's credit may be; but it may not be a bad policy to give *yourself* the benefit of the doubt when any inquiry looks to be more than an idle request for a catalogue.

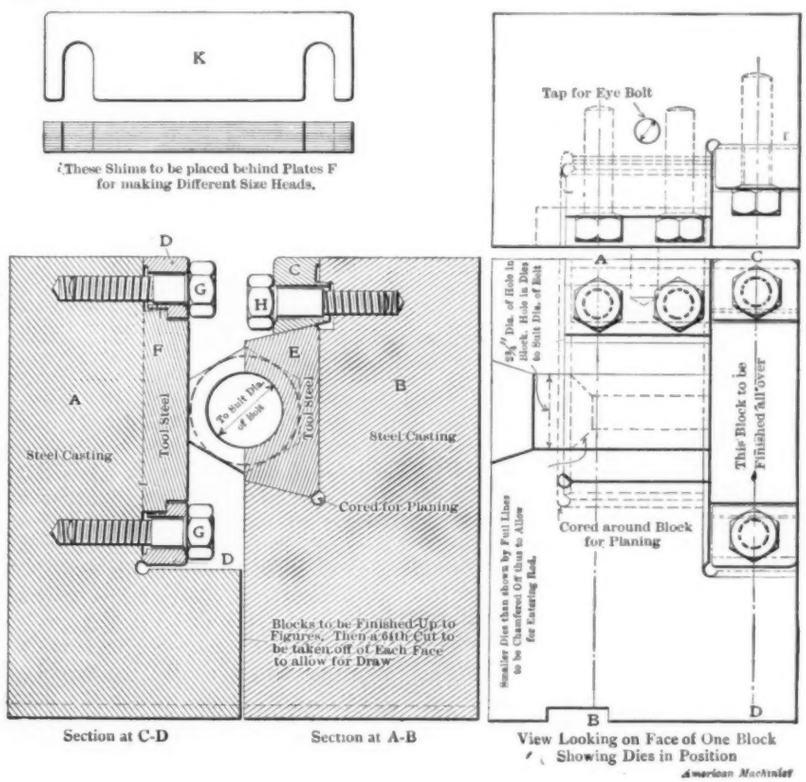
X. Y. Z.

Special Dies for the Bolt Machine.

The old method of making dies for the bolt machine was quite an item not only in the first cost, but in the renewing and patching up of the old ones, especially so as they took in a range of sizes from half an inch to three inches. Each pair of dies were the size of the blocks marked *A* and *B*—15¾x10½x8 inches—in the illustration, and could be used for making two sizes of bolts. This made it necessary to have a great many heavy pieces to handle every time a different size bolt was wanted. To make a set of dies for the different sizes of bolts not alone took a great deal of steel, but the machine work and hand-work on them in the tool-room was also excessive. These blocks being soft steel, soon become worn and the corners rounded off and unfit for bolt making, especially so for those for Government work. The die-holder and dies shown are the outcome of trying to overcome these obstacles and to make something that could be renewed with little expense and also whose faces could be hardened to withstand the wear and tear of work.

The holder consists of two steel castings *A* and *B*, machined to take the tool-steel dies *F* and *E*. After they are clamped in place in the machine they do not have to be handled again for inserting or removing the dies.

The dies consist of two tapered pieces of tool-steel hardened, marked *E* in the illustration, which are used to grip the stock while the plunger in the machine is forming the head between the faces of the pieces marked *F*. One pair of the tapered dies *E* can be used for making two sizes of bolts; for instance, the dies used for making 1⅛-inch rough bolts can also be used for making 1-inch finished bolts, as the same stock is used for both. The difference in the size of the hexagon head is made up by placing the shims *K* under the tool-steel piece *E* and clamping it in position with the bolts *G G*. Thus with different thicknesses of shims, any width across the flat of a hexagon can be made.


K
These Shims to be placed behind Plates F for making Different Size Heads.
Tap for Eye Bolt
D
G
H
C
F
E
A
B
Steel Casting
Tool Steel
To Suit Dia. of Bolt
Steel Casting
Cored for Planing
Blocks to be Finished Up to Figures. Then a 64th Cut to be taken off of Each Face to allow for Draw
Section at C-D
Section at A-B
Dia. of Hole in Block. Hole in Dies to Suit Dia. of Bolt
This Block to be Finished all over
Cored around Block for Planing
Smaller Dies than shown by Full Lines to be Chamfered Off thus to Allow for Entering Rod.
View Looking on Face of One Block Showing Dies in Position
American Machinist

SPECIAL DIES FOR A BOLT MACHINE.

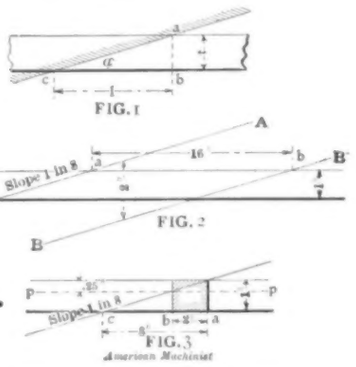
To insert or remove the dies, the bolts *G G* and *H H* have merely to be loosened, and they can be slipped out the end. The shims can also be put in from the end of the block, the holes being made horse-shoe shape to slip over the bolts.

The method of making the bolts in the machine is the same as with any other die, so it needs no explanation.

San Francisco. C. V. L.

The Cutting Capacity of Power Presses.

In an article under this heading, at page 496, E. W. Zeh makes one or two mistakes which I wish to correct.



THE ACTION OF SHEAR BLADES.

Formula (3) states that the cutting length

$$l = \frac{A}{t^2 p s}$$

where

A = accumulated work (not power) available from the fly-wheel.
t = thickness of material to be sheared.
s = ultimate resistance to shearing.
p = penetration, given as a fraction of the thickness.

Unfortunately this was misprinted

$$l = \frac{A}{t^2 t s}$$

but equation (4) clearly shows the intention. This will be quite clear if I say

Area in shear $= l \times t$.

Pressure required $= l \times t \times s$.

This acts through the distance of penetration; therefore the work required

$$A = l \times t \times s \times p\, t = l\, t^2\, p\, s.$$

When cutting with an inclined cutter, the formula given by Mr. Zeh for the pressure is $P = .5\ t^2 \cot. a\ s$, or $P = .5\ t\, l\, s$. That is, the area in shear is the triangle *a b c*, Fig. 1. This, I think, is clearer.

The following example will prove that this is not correct. Take two positions of the cutters of a plate shear, near the middle of the cut, so that the area in shear is constant, as in Fig. 2. The plate is 1 inch thick, and the slope of the top blade is 1 in 8. If the blade descends 2 inches in moving from position *A A* to *B B*, the length of plate sheared is equal

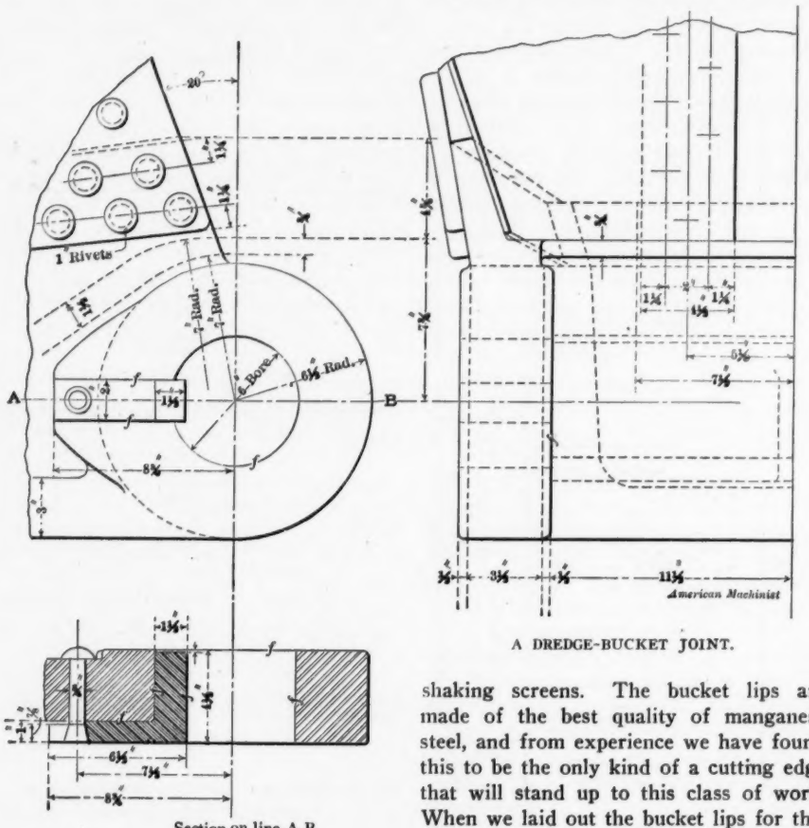
to $a\,b$—that is, 16 inches. If we take the formula $P = .5\ t^2$ cot. $a\ s$, the pressure exerted by the top blade $= .5 \times 1 \times 8 \times 27$ (taking $s = 27$ tons) $= 108$ tons. As this acts through 2 inches—the vertical movement of the blade—the work done $= 2 \times 108 = 216$ inch-tons. But I take it that the work done in shearing a plate is the same, whether the blades be parallel or inclined; the object of giving slope to the top blade is merely to reduce the pressure.

Let us try the formula first given to ascertain the inch-tons required to shear 16 inches of 1-inch plate.

$A = l\,t^2\,p\,s$

p. for 1-inch steel plate $= .25$

$A = 16 \times 1 \times .25 \times 27 = 108$ inch-tons.



A DREDGE-BUCKET JOINT.

The reason for this difference is that the formula $P = .5\ t^2$ cot. $a\ s$ is wrong.

In Fig. 3 the thickness of the plate is clearly shown, with the line of the shear blade across it. The dotted line $p\ p$ shows the distance of penetration. Of the length of plate $a\,c$, in contact with the shear blade, the part $b\,c$ is severed, and the only part that offers resistance is $a\,b$. As the slope of the cutter is 1 in 8, and the penetration is .25 inch, $a\,b = 2$ inches, and the area in shear $= 2$ square inches, pressure required $= 2 \times 27 = 54$ tons, and the work done as the shear descends 2 inches $= 54 \times 2 = 108$ inch-tons, which agrees with the result obtained from $A = l\,t^2\,p\,s$. Of course this does not take into account the work done in bending the plate by the inclined cutter.

Manchester, England. R. SHAW.

A Dredge-Bucket Joint.

The accompanying illustration shows in detail the construction of the front eye of a cast-steel bucket bottom for a 9-cubic foot continuous-link bucket gold dredge, which design, after a year's continuous service, has proven to be very satisfactory.

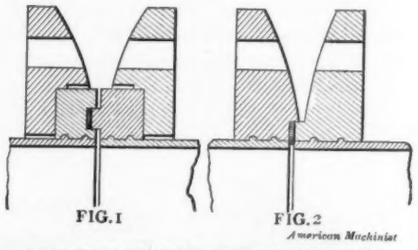
These buckets form an endless chain, which passes over two tumblers, the upper one of which is driven by a 150 horsepower induction motor, there being about ninety buckets in the chain, each one weighing a little over a ton. The buckets dig up the gravel and carry it up to a hopper, from whence it goes on to the shaking screens. The bucket lips are made of the best quality of manganese steel, and from experience we have found this to be the only kind of a cutting edge that will stand up to this class of work. When we laid out the bucket lips for this dredge, we took an old bucket lip that had been in service for about a year and measured it up, and thereby found exactly where the points of wear were, and we added to our bucket lips at these points enough metal so that when they had worn down we had increased their life just 100 per cent.

The conditions to be dealt with in this class of work are of the severest nature, and there has been a great deal of time and money spent in trying to obtain a satisfactory method of holding the bucket pins in place in the front eyes of the buckets. These bucket pins, which are made of the best quality nickel steel, oil tempered and annealed, have to be taken out quite frequently, owing to the great amount of wear which is forced upon them as they are dragged through the gravel and sand. The eyes have been made with a recess in them which was covered with a cap, and the remaining space filled up with grease, the caps being screwed in flush with the face of the eye, the principle being the same as a grease cup, but our experience was that the caps were smashed in or so mutilated that we could not remove them within the short period of two or three days.

The rear eye of this bucket extends from face to face, about 23 inches, and it has a half bushing made of manganese steel which is made so that it can be very easily removed from the eye when necessary. H.

More New Forms of Flanged Pipe Connections for High Pressures.

I have read with great interest the article by Luther D. Lovekin at page 764, Part I, Vol. 28, about some new forms of flanged pipe connections. Without doubt, all the forms given are good for pressures up to 20,000 pounds per square inch, but for high pressures up to 50,000 pounds and more per square inch, the best connection for high-water pressure is a flange-to-flange connection. The forms given in the article show a direct contact between the water and the jacket. The gasket is destroyed by the strains which always exist in hydraulic pipes under high pressure, and parts of it fall into the pipe, so that after some time the water works its way along the flange to the outside. Also the variations of temperature and consequent expansion and contraction make the connection loose and allow a compression and expansion of the gasket, which also destroys it. The best connection is to braze rings or flanges on the pipes, and use Allen's loose flanges. Make the flanges male and female, so as to have some space between the male and female if the flanges are connected by bolts. In this space lay a gasket, which is compressed by the bolts. The water pressure now presses the gasket toward the outside and thus ensures a very perfect connection. Fig. 1 shows a connection, described in this letter, while Fig. 2 shows another connection, which avoids brazing, but has nevertheless the same advantages. Another advantage of the connection Fig. 1 is that the pipes need not be turned on the ends.



TWO NEW FLANGED PIPE CONNECTIONS.

JULIUS OELSCHLAEGER.

Berlin, Germany.

Ball or Roller Ratchets.

At page 706, G. C. H. asks for information on roll or ball clutches, and shows a sketch giving dimensions required that shows he has a wrong conception of this style of clutch, as will be seen by referring to Fig. 1. I have had quite a little practical experience with this style of clutch in its various forms, and working under various conditions, and the sketches shown are of clutches that are practical.

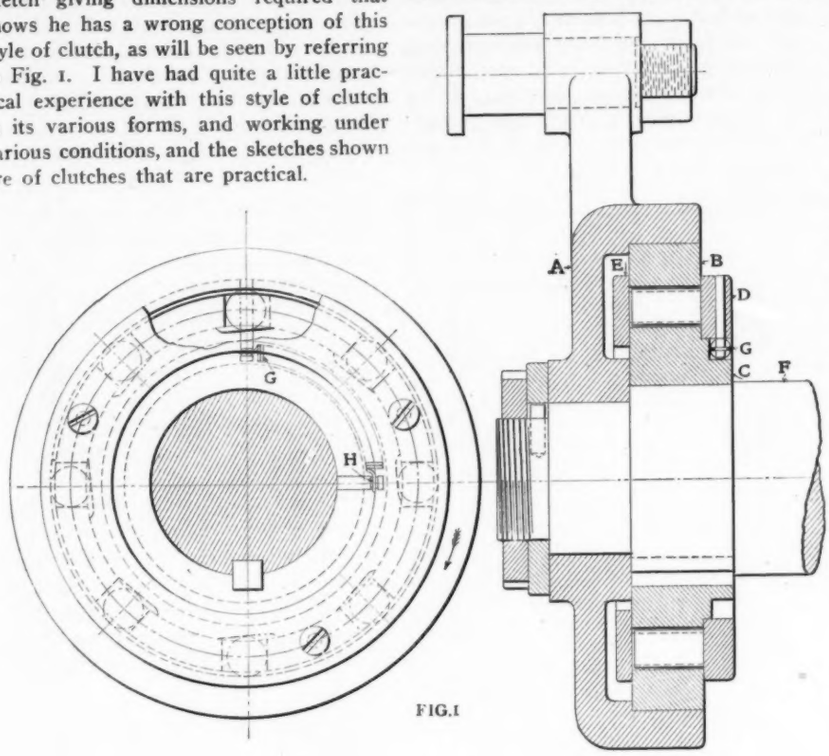
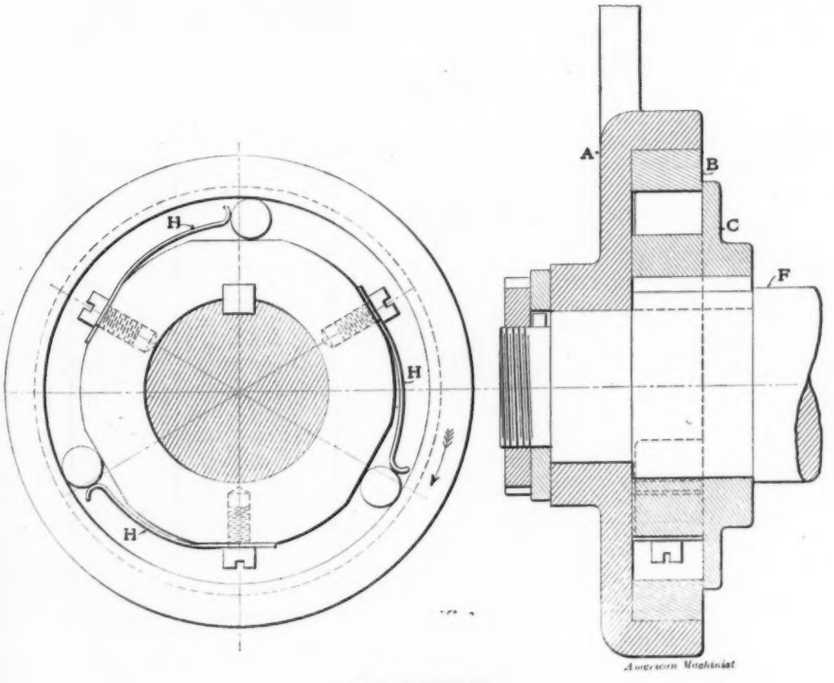


FIG. 1



ROLL CLUTCHES.

A description of this style of clutch, Fig. 1, is as follows: *A* is the body of the clutch, which is free to rotate on the shaft *F*, and to which a reciprocating motion is given by any means desired. As shown in the sketch it is through the medium of a connecting rod which is operated by some other moving member of the machine, the movement being anything that may be desired from nothing up, the clutch always feeding the desired amount. *B* is a hardened tool-steel ring forced into the body *A*, and ground inside and outside before pressing into the body.

C is the clutch, which should always be hardened, and has as many flat spots milled on its periphery as there are rolls in the clutch; in this case, eight. The number of rolls, however, can be made to suit requirements. The angle that the flat spots are milled off to depends on the work that the clutch has to do. The diameter of the rolls should be larger than shown by G. C. H. For the size of clutch shown by him they should be at least of ½ inch diameter. His length, ⅞ inch, is all right, as the rolls should not be over twice the diameter in length, and are usually a little shorter. The rolls are carried in a cage *D*, which runs freely on clutch *C*, and has about 1-16 inch clearance between itself and the ring *B*. The ring *E* is fastened to the cage with countersunk screws, to keep the cage from dropping out. Any other means can be employed that will keep the cage in place, as that is only a matter of detail. The cage has slots milled through it to suit the number of rolls, and about 1-32 inch wider than the diameter of the rolls. The cage is usually made of a brass casting, and its action is to force the rolls up against the ring and make them bite when the ring moves forward. The pull on the cage is obtained by means of a close-wound coil spring *G*, one end of which is fastened to the clutch at *H*, and the other end to the cage by a pin as shown. The spring should have just enough tension to move the cage quickly.

In action, the body *A* has a reciprocating motion, and it is desired to rotate the clutch and shaft in the direction of the arrow. On the forward movement of the body the rolls bite instantly with no lost motion, as they are forced against the ring by the cage. On the return stroke the rolls let go instantly and the clutch, cage and rolls remain stationary.

In order to insure the clutch remaining stationary and feeding accurately, a friction device must be provided on shaft *F*, fiber collars clamped between one of the bearings being a very good method if it is convenient to use it.

This is a very powerful and very reliable clutch. It will sometimes break a roll when feeding, before letting go. No lubricant of any kind is required, as the clutch runs best dry, although a little oil does not seem to affect its working properly.

The angle to which the flat spots are milled off depends on the work that the clutch has to do. If the load is very heavy the angle should be about 5 degrees, but if the load is light it can be made as great as 10 degrees. The greater the angle the more freely the clutch lets go on reversing. The cuts should always be made as shown in Fig. 1, as the form shown prevents the cage from getting out of position.

Fig. 2 is a modification of Fig. 1, which is used for feeding power presses and in places where the load is light and the feed is required to be very close. In this clutch the body *A* reciprocates as desired the same as the body of Fig. 1, and has a steel ring *B* pressed into it the same as the other style. The clutch *C* is of gray iron

and has three flat spots milled on it for the three rolls. These flat spots should be milled off enough so that the rolls will be off center quite a little when they bite as shown. The rolls are held up against the ring by means of the three flat springs *H H H*, which can be reversed, thus reversing the clutch. The shaft should have a brake on it the same as the other clutch. If the load is very light the steel ring can be left out altogether or made of soft steel if desired, but the rolls should always be hardened and ground. This style of clutch is much cheaper to make than that shown in Fig. 1, but is just as good and reliable when the load is not very heavy.

A clutch like Fig. 1 is frequently used where we want to make one or more revolutions at will, at regular or irregular intervals of time; the only difference being that the body of the clutch runs all of the time in the direction that it is desired to operate the clutch. The clutch body is usually cast in the pulley or gear, as the case happens to be. The roll cage in this case should be made of machinery steel, and have a lug on the outside that will come in contact with a tripping dog swung from a stud on some stationary part of the machine. The dog being swung up against the cage and the lug on the cage coming in contact with it, the cage is suddenly stopped, thus knocking the rolls backward out of the bite and making them let go; the shaft and the clutch remaining stationary until such time as the dog is tripped again, when the cage instantly throws the rolls forward until they bite on the ring, and the clutch starts and makes one or more revolutions, according to the time that the dog is depressed. On large clutches of this type the limit of usefulness is reached when the inertia of the shaft and the parts on it is too great to permit of sudden stopping and starting, as the start is sudden and the stopping is practically the same.

I have made several of these clutches with rings 2 inches inside diameter that are running 250 revolutions per minute and are giving perfect satisfaction. The larger clutches can be used up to 200 revolutions per minute and the smaller ones up to 400 revolutions per minute.

These clutches will work all right with balls instead of rolls, but the work must be very light. I would not advise the use of balls under any condition, as with them we can only get point contact, while with rolls we can get line contact and they are not so liable to dig into the ring and clutch. W. H. A.

An Interesting Press Job.

In manufacturing the brass cap, Fig. 1, we used the rather unusual press tools shown in Figs. 3 and 4. The job was done in two operations: First the shell, Fig. 2, was drawn in the ordinary way, and after being trimmed on the edge *a* it was finished in the expanding die shown in Fig. 3. In order to extract the shell after it had been expanded, it was necessary that the die should be made in halves, and two pieces of die-steel were planed, doweled and clamped together and finished, with the grooved hole equally halved between them. One block *B* was screwed down to the gray-iron plate *D*, while the other *C* was free to slide upon it, guided by the machine-steel block *E*. Placed between the die blocks *B* and *C*, and retained in position by holes in the same, were four strong coiled springs *F*. Working on a fulcrum pin *G*, which screwed into *E*, was the machine-steel cam *H*, which was conveniently placed to open and close the die against the pressure of springs *F*. The method of using was briefly as follows: The shell having been placed in the die, which, of course, was closed, the tool *I* (the diameters of which corresponded exactly to the inner and outer diameters of the shell) descended to the position shown in Fig. 4 before doing any actual work. It will be readily seen that by reason of the tool being an exact fit in the shell, and the shell bottoming in the die, when the tool continued to the finish of its stroke the flow of metal was bound to force the shell outward into the grooves. Then the tool was withdrawn, the cam thrown back and the finished shell extracted. C. F. H.

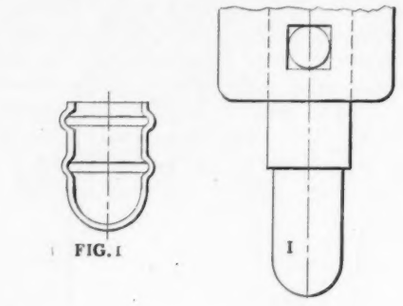


FIG. 1

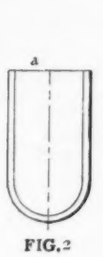


FIG. 2

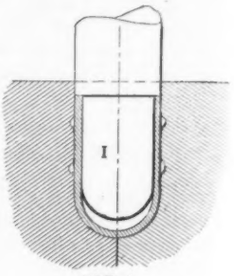


FIG. 4

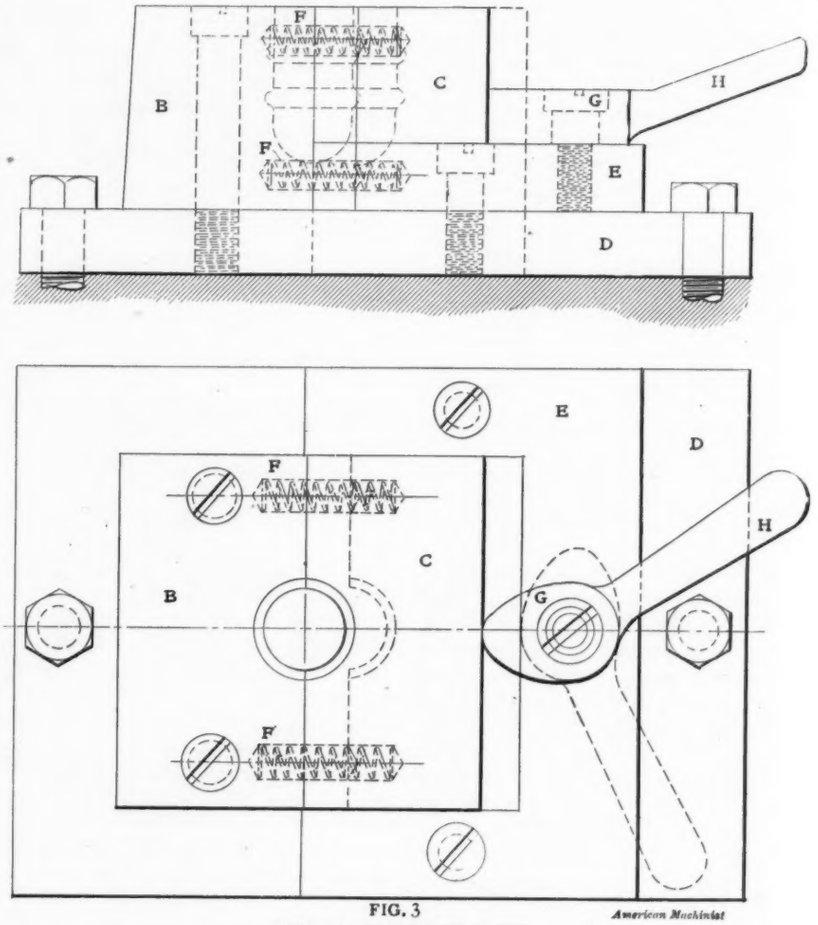


FIG. 3

DIES FOR EXPANDING A CUP.

American Machinist

Piston-Ring Fixtures.

From time to time I have seen in the AMERICAN MACHINIST articles bearing on methods of machining small piston rings.

which have been a great help in developing the methods here described.

The recently improved molding machine with stripping plate insures almost perfect castings, so much so that it is possible to fill a barrel, Fig. 1, with piston rings in the rough, after grinding the outside on an emery wheel to take off any small irregularities that may interfere.

The barrel is bored, and at *A* fits a fixture which is mounted on the lathe carriage, to which it is clamped by the surface *B*. The seat *A* is located off center to allow for the eccentricity desired in the rings, which are held in the barrel by means of casting *a* and swing bolts, and are bored by a boring-bar carried between the lathe centers.

Fig. 2 shows the method of facing the sides of the rings on an engine lathe after they are bored. Head *a* fits the lathe spindle and expanding disk *b* chucks the ring *c*. After the ring is placed on the expanding disk the flange *d* is brought up to straighten it. Hand-wheel *e* is then turned, serving to both expand the disk and draw it up solidly against *a*. The facing tools *f* are held in a special tool-post, facing both sides at the same time.

Fig. 3 shows a spider for turning the outside after the rings are faced. It is filled full of rings which are held between clamp *f* and shoulder *g*. The spider is mounted on eccentric centers for the purpose already mentioned.

I. N. QUIRE.

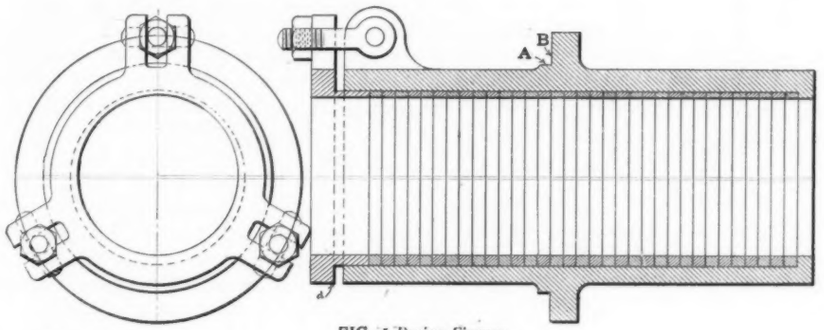


FIG. 1 Boring Fixture

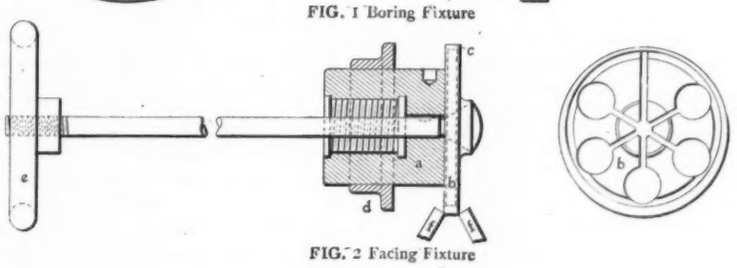


FIG. 2 Facing Fixture

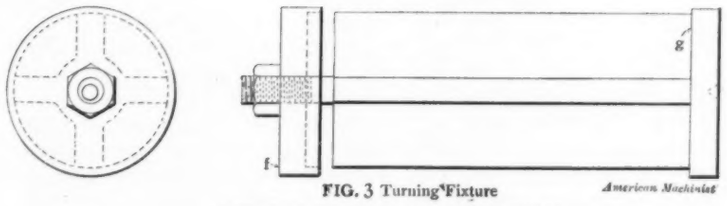


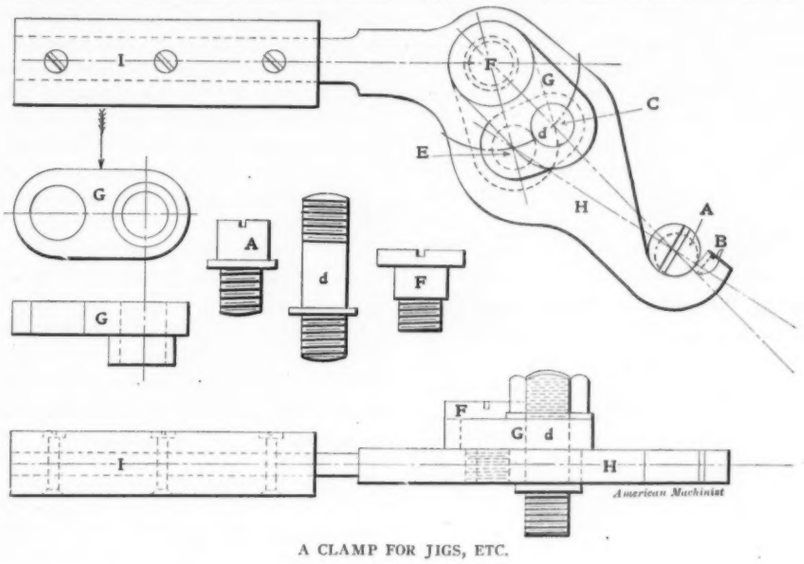
FIG. 3 Turning Fixture

FIXTURES FOR MAKING PISTON RINGS.

A Clamp for Jigs, Etc.

This clamp was designed for locking lead molds. I have extended its use—after some modifications—to locking jigs and other fixtures used in tool and machine shops.

The stud *d* is screwed into one member of the jig and the eccentric screw *A* into the other. The link *G* has a hole in one end of it which passes over the stud *d*, the other end of it swings on the shoulder screw *F*. The part *H* has a circular slot—having *F* as a center—which reaches from the center *C* to the center *E*. The stud *d* is a sliding fit in this slot.



A CLAMP FOR JIGS, ETC.

It is obvious that the distance *EA* is greater than *CA*, therefore when the stud *d* is at position *E* it is further from *A* than when it is at position *C*; and it is also evident that swinging the handle *I* will move *d* from position *E* to *C*, or *vice versa*. As the hooked end *B* of *H* is liable to wear, the screw *A* is made eccentric, so that any wear may be taken up by adjusting the screw.

The action of the clamp is this: The parts of the jig are brought together, the hook *B* being swung out of the way to permit this. The stud *d* is in position *E* when the handle *I* is swung—on the stud *d*—in the direction of the arrow until *B* hooks over *A*, any further movement of *I* slides the circular slot in *H* along the stud *d*, drawing *A* and *d*—and consequently the two members of the jig—closer together. HENRY BOETTCHER.

A Taper Gage.

At page 708, H. E. R. Manbrand gives a rather detailed description of a taper gage, which would lead one to suppose that he had actually made and tried one. I can hardly believe this, as I feel sure that if he had he would have immediately consigned it to the scrap heap, because he would not be able to obtain any sort of a fit with the tool. Any section of a cone, in a plane parallel to and at a distance from the axis, is, in outline, a parabola; consequently, it is impossible to rest a cone on two parallel edges any appreciable distance apart. Everybody knows that to turn a true taper it is necessary to set the lathe tool at the same height as the centers. If this is not done the "taper" will be hour-glass shaped. By setting the tool above or below the centers we get an illustration of what the proposed tool would do to a taper gage; if tried, it would be found to rock considerably on the edges of the Y-shaped legs. A very small taper, resting wholly below the edges, would of course rest firmly, but it

does not appear from the illustration that this is intended; neither would it be practicable if the same gage were to be used for both large and small work, because if the sides of the V were high enough to accommodate a large piece, they would obscure the "sighting" on a small piece. The tool could, however, be made very serviceable if, instead of the continuous Y-shaped leg, it had two V-blocks with fairly narrow faces, adjustable lengthwise on the leg. In that way a taper piece would rest firmly on the V-blocks, and if the other leg is reasonably wide, or else moves in the plane of the axis of the cone, there is no reason why it should not give good results. H. K. HARRING.

Long Work in a Short Grinder.

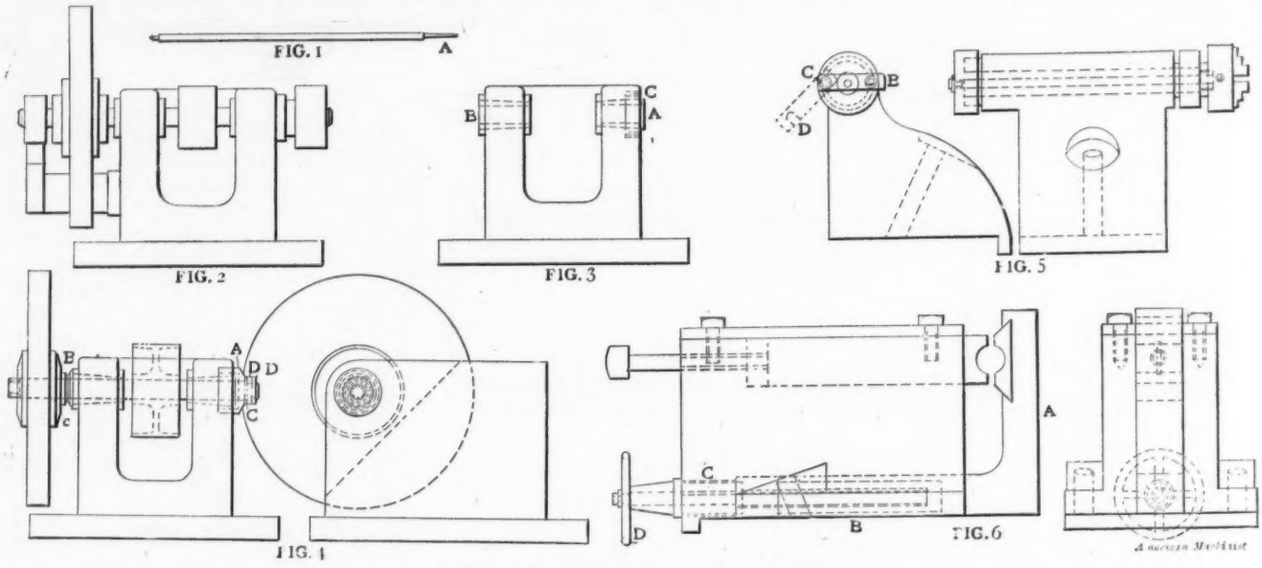
After coming from a conference at the office with the foreman, the boss imparted the following news to me: "You know the grinding that they are doing on the next job and the grinder they are doing it on; well we have got to do it now, and they are going to give us their grinder to do it on. Isn't that about the limit?" The work they were doing was grinding short shafts 11-16 inch diameter and about 20 inches long, removing .010 inch of stock. The grinder was nowhere near heavy enough for the work, and they had pushed it to the limit trying to grind the pieces at a profit.

We had a steady job of grinding, which took one of our large grinders, not on account of it being heavy grinding, but because of its length. This job was grinding the taper tip *A* in Fig. 1. The large end of the taper was ⅝ inch diameter; the small end, 9-16 inch; length of tip, 2½ inches; work over all, 39 inches; diameter of straight part, ⅞ inch.

The boss said: "I propose that we take this job of grinding the 11-16-inch shafts and put it in one of our large grinders, where it can be ground at a profit. As this will not be a steady job it will give us the grinder for other work. Then take this grinder that they are going to give us, remodel and repair it, and grind the taper tips in it, holding the work in a chuck with a hollow spindle."

It struck me as a good idea, so he told me to go ahead and get out the drawings. I looked the grinder over and found the driving and reversing mechanism to be in good condition, but the wheel spindle was all worn out. I tackled the wheel shaft first. As it came to us it looked like Fig. 2. To remove the wheel the outside bearing and bracket had to be taken off, which took too much time.

Fig. 3 shows the stand stripped of everything except the boxes. The boxes were of brass with a straight hole tapered on the outside of the box for adjustment, box *A* having one nut and *B* two. At *C* the stand was counterbored and a fine thread cut on the shell; this had been used for moving the spindle endways.



GRINDING LONG WORK ON A SHORT GRINDER.

Referring to Fig. 4, which shows the stand as I changed it over, *A* is a soft-steel collar, case-hardened and threaded to fit the shell and screwed up tight against the bottom of the counterbore. *B* is another collar which fits the thread on the box and serves a two-fold purpose—as an adjusting nut and an end bearing. *C C* are brass washers. *D D* are adjusting nuts for end wear. The wheel hangs outside of the stand and a change of wheels can be made in something like two minutes. The wheel cover is not shown.

I next got at the headstock and Fig. 5 shows the results. The spindle was made with a 1-inch hole and was fitted with a chuck. Something, of course, was needed for a back-stop for the work, so as to bring all the pieces in the same position while grinding, as the size is gaged from the pointed end of the work. *A* is a collar which fits over the adjusting nuts on the spindle, and is held there by three screws whose ends are bedded in the nuts. *B* is a piece of hardened steel which hinges at *C*, slot *D* dropping over the screw *E*. The dotted lines show the stop swung out of the way to admit the new piece of work. A rest was needed, so I designed the one shown in Fig. 6, known as a clamp-rest. *A* is the clamp, which slides in the slot *B*. The screw *C* and hand-wheel *D* move the clamp back and forth. An emery wheel 14 inches in diameter, 1½ inches wide, was used. We grind twenty-five pieces per hour, removing 1-32 inch of stock. The machine has run constantly for a year without needing any repairs, and everything works just as well as when first started up.

PAUL WESLEY.

Technical Ignorance in Strange Places.

I recently came across two other instances of the above. While going through a large works with the *mechanical engineer* of the concern, we stopped in front of a motor-driven machine, the spindle of which was geared to run very slowly. The engine that ran the electrical generator for the entire works developed only 250 horse-power.

Turning to the M. E. I said: "What is the ratio of the gearing in this machine?"

To my surprise he replied: "You can easily get that. The motor is 15 *horse-power;* that drives it; out at the face plate the machine develops 6,000 *horse-power, because it goes so slow.* If you divide 6,000 by 15 it gives you 400, so the ratio of gearing is 400 to 1."

In a "write-up" of a new power hack-saw, which appeared recently in a trade paper devoted to hardware, tools, and machinery, the following statement occurred:

"The saw is back-geared with a ratio of 3 strokes to 1 revolution of the pulley."

DIXIE.

Drawing-Room Practice.

At one time I took charge of a drawing room where an unusual number of mistakes in drawings were getting into the shop.

There were several causes for this, which included an insufficient force due to inability to get experienced men and the necessity of breaking in new men from the shop, the inherent carelessness of some men, and an insufficient system of checking.

In devising a suitable system which would remedy these mistakes, it was recognized that the man who made the drawing must be held accountable as well as, and, if anything, more closely than the checker, in view of the doctrine of probabilities that the greater the number of mistakes in the drawing as it leaves the draftsman the greater the liability that some of them will pass the checker.

With an insufficient force and the likelihood that it would remain so for some time, a set of rules must be devised which would not necessitate putting too much time on the drawings, and yet they must be complete and contain all the information necessary for building a line of machine tools.

It was the practice and is still—and I believe there is none better—to make the original drawings and details on paper, dimension the paper drawing for the patternmaker and the tracing for the machinist.

With these points in view the following general rules were established:

Drawing sizes—Paper trimmed to A 36x24, B 24x18, C 18x12. Each draftsman requested to trim his own drawing before turning it over to the checker. Title to be in lower R. H. corner. Drawing number to be in figures at least 5-16 inch high, in lower R. H. corner and also in upper R. H. corner facing away.

Use regular form for title, and plain freehand letters.

DIMENSIONS.

All necessary dimensions to be given on paper drawing.

Only finished dimensions and from rough to finished surfaces to be given on tracings.

Distances between center lines, from finished surface to center lines, fitted diameters, tooth sizes, and speeds to be given on assembled drawings.

Figures for dimensions to be not less than 5-32 inch high, and fractions ⅛ inch, and should be kept uniform.

All dimensions should be taken relative to or from center lines and finished surfaces, and should be given with reference to the convenience of the machinist and patternmaker. For instance, the hubs of pulleys, gears, etc., should have dimensions from each face to face of rim, as well as from face to face of hub.

Castings having planed surfaces of different heights should be dimensioned one face from another, so they can be readily measured with a surface gage, as well as from some center line or surface as a starting point.

Where rough surfaces are, when assembled, in proximity, in detail, dimensions should be given from each rough to a finished surface, otherwise the necessary distance may not be maintained in machining, and the rough surfaces come into interference.

Finish marks *f* should be placed on all finished surfaces of castings or forgings.

All threaded parts should be shown by two lines.

METHOD OF INDICATING THREADS.

All threads should be marked by number of threads per inch if not standard or U. S. S.

Symbol number and size of screw should be given on detail drawing at threaded hole.

Where several holes are alike on the same center line, one dimension will generally suffice for all.

Drill size should be given with each tap size.

Depth of drilled hole given to lip.

No adding or subtracting should be left to the machinist.

ASSEMBLED DRAWINGS.

Complete part list, with number of pieces, should be placed on each assembled drawing.

For shop use make plenty of sectional views showing parts at section and little beyond.

On assembled drawings mark nature of fits at each cylindrical part, N., P. or R., as case may require.

Make cross-sectional lines about ⅛ inch apart for C. I., 1-16 inch for steel, and 1-16 inch alternately full and dotted for bronze.

Allow plenty of clearance for rough surfaces in proximity, for shrinkage is not always to be relied upon, and cores are liable to shift.

One-half inch is none too much on bases or beds of two or three tons weight, and larger ones may require more.

Scale should be full size wherever possible, and B and C size sheets should be used wherever practicable.

DETAILS.

Each detail should be divided up into rectangles, according to the size of the piece, each piece complete on its own rectangle, with title, material, number of pieces, symbol number and drawing number.

Enough views should be shown to make every part plain; but cylindrical work, such as pulleys, gears, bushings and shafts can be readily shown in one sectional or side view, marking abbreviation "dia." after each such dimension, and showing partial detached view where necessary for keyways, arm sections, etc.

Fitting marks should be placed on all cylindrical surfaces—*R* for running, *P* for pressed, *N* for neat and *C* for clearance, giving dimensions in decimals, with proper allowance for fit, as shown in tables of fits.

The shaft or outer diameter is to be the standard, and the proper fitting allowance allowed in the hole.

In general, .002 to .003+ should be allowed for running fit, 0 for neat fit, and .002 to .003— for a pressed fit.

Standard sizes of screws, pins, collars, gibs, T-slots, oil covers and keys should be used from the book of tables, wherever possible.

Consult toolroom list for all tapers, special taps, hobs and other tools.

Each detail sheet shall contain a list of all the standard screws used in the parts shown on that sheet, given in a conspicuous place—provided such screw is taken from screw list.

TO KEEP IN MIND.

Speeds; direction of movement; molding; weight; machining; form suitable for holding when machining; ease of assembling; adjustments for assembling; allowance for casting variations; to be manufactured or special.

TO CONSIDER IN CHECKING.

Duty, molding, machining, assembling, dimensions, finish, number of pieces, material views, with relation to each other, symbol numbers, indexing.

MARKING.

The time consumed is to be marked by each draftsman on his drawing.

The checker will place on each drawing a figure indicating the number of mistakes found on this drawing, counting a wrong dimension as 1, an omitted *f* mark as 1, an omitted necessary machinist's dimension as ½.

A record of these errors will be kept for reference, and a certain percentage of freedom from error will be required from each draftsman before advancement.

These percentages will be as follows: 90 for tracings and 80 for paper drawings.

A record of the time consumed on each drawing will also be kept for reference.

These rules were put into effect about a year ago, with the addition that at the end of every week a statement of the number of drawings made by each man, and the number of mistakes found on them, was posted in a conspicuous place on the blackboard. At that time the force included five men; now it includes ten.

The great majority of the drawings were of a size 18x24 inches, and the larger and smaller sizes being about equally divided, one of these medium-sized sheets represented a very fair average for the whole.

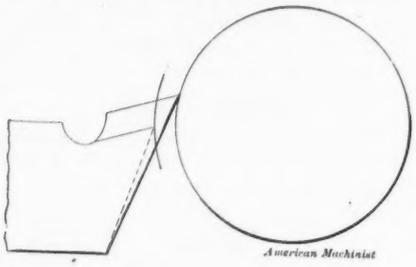
From the records for about a year it

was found that the average cost of one of these sheets, including the drawing and tracing, and reckoning in all the drawing expense, supplies, blueprinting, etc., was at the first two months about $5.50, and the last two months about $3.50. The percentage of accuracy was increased from 75 to 88.

I shall be glad to hear from some of our friends along this line, and to know where we stand. H. F. NOYES.

Compound Rests—Height of Tool-Posts.

What Mr. Wheeler has to say about compound rests, at page 672, attracted my attention because I have run a lathe with a compound rest of Mr. Fish's style, and know about what it is. For a job shop, or a shop where men take turns at a lathe, it is a positive nuisance, not but that it will hold a tool all right, but because it has no adjustment for the height or angle of the tool. On the machine that I ran the tool plate was about 1¼ inches below the line of centers. We had tools of every description, and some that could not be described, from side tools of ½x1-inch steel, ground away down, to



PRESERVING CUTTING ANGLES WHEN GRINDING TOOLS.

new diamond points of ¾x1½-inch steel that stood up 2 inches high or more. Of course, it is impossible to do anything with such a rest unless the tools are forged to suit and ground just right, for there is only one way to adjust them, and that is to shim up underneath.

What I did was to gradually accumulate a stock of ⅝x1¼-inch tools that were right and keep them hidden away. I found that by grinding side tools mostly on the face instead of on top, I could keep them the right level to square up clear to the center with for quite a while. Diamond points I kept running a long time by grinding back the point as I ground off the top as in the sketch, keeping the angle which the tool presented to the tool the same all the time. Of course, for small work I had to use a tool that had been ground close to the center height. But when anyone else ran the machine there was trouble, because all the tools that would fit it gradually got into my kit; so the other men shunned it, and I came to run it ultimately. With proper tools, it is a pleasure to run it, but without it is a farce.

Why don't the tool builders get together and establish standards for the height from the lower edge of the tool (when level) to the line of centers? Then, with a lathe of any given size, we would know at once just what size tool should fit it, and special tools could interchange between different lathes. For the sake of seeing if anyone will agree with me, I suggest the following:

For lathes 14 inches or under, 1 inch; 15 to 20 inches, 1¼ inches; 22 to 48 inches, 1½ inches. For larger lathes no standard is necessary.

This would allow tools to be ground on the end of stock-size bars of steel without forging, if desirable, and they could be used to advantage in lots of places, and tools would interchange. The trouble with using solid tool-holders is not so much the trouble of forging tools correctly as it is that a tool forged correctly for one lathe cannot be used on another without reforging.

Why don't shop proprietors get on to the way we store away lathe tools? I heard the boss bragging to a visitor the other day that his system was so complete that he could locate every tool at a moment's notice. I knew of some he couldn't locate without a divining-rod. If they would only check us out a whole set when we go into a shop, and make them so we would know them, and then let us have them dressed to suit us, we would be saved from stealing them. The time that I have spent regrinding other men's botches would pay for a number of sets of really good tools. CON WISE.

A Trick in Addition.

There is a trick employed in the addition of long columns of figures that is helpful to those who are not experts, and find it difficult to carry large numbers in the mind. It consists in putting down a dot or short mark for every ten, and adding the unit figures until the column is finished. The last unit figure is the unit figure in the sum and is put in its proper place, and the tens are counted up and added in the tens column.

542
7.5.6.
645
538.
8.9.1
29.5

3,667

Thus in the first column 5 + 1 + 8 = 14, put down a dot for the ten and add 4 + 5 + 6 = 15, put down the dot and add 5 + 2 = 7, put down 7 in the sum and add the two tens to the next column 2 + 9 = 11, put down dot and add 1 + 9 = 10, and so on. I find that this method reduces the change of error.

23—1—13.

Foreign Markets for American Machinery.

There is a good opening in Baghdad, and, indeed, in many similar towns throughout Asia Minor, for cheap and efficient manual and animal power pumps. Baghdad is quite unprovided with a proper water supply, and the inhabitants have to obtain their water from the river flowing through the town. What is really needed is a pump of the type stated above for raising the water from the river into the cultivated land on the banks. Better still would it be if the pumps could be supplied with a simple apparatus for cleansing the water of the silt it contains. This would certainly make the pumps more salable and of greater value. It is a suggestion well worth trying, and enquiries might be put through some of the importing houses in the town.

Enormous damage was done last year during the revolution in Uruguay, to the fencing wire used by farmers and others to enclose their land. There is a large demand for wire of this class, and American exporters might as well supply it as Germany or the United Kingdom. The price of the article furnished by England and Germany is now about equal, but Britain sends the best quality for the money.

There is an excellent opening in San Luis Potosi, Mexico, for a small, portable machine for cleaning the fiber called ixtle. This is a fiber extracted from the leaves of the lechuguilla plant. The work of gathering and scraping the leaves is both hard and disagreeable, and the owners of ixtle lands have great difficulty in securing efficient men used to the work. A number of different machines have been invented for cleaning or scraping the leaves, but up to the present none have given satisfactory results, on account of the fact that most of the machines are too heavy and unwieldy, and also because they have to be run by steam power. What is wanted is a machine that can be easily moved about from place to place and worked either by hand or horse-power. The price of the machine would have to be reasonable and the parts few and simple, and easily replaced. Apart from this there is a demand for steam pumps, which are being used extensively for irrigating purposes, and are bringing under cultivation large tracts of land that were previously unused. Makers of windmills would do well to explore the market, as many of them are in use; while American farm machinery is becoming favorably known among the agriculturists. There are indications that the next two or three years will see a continued increase in the number of new industries and manufactures in Mexico, especially in Mexico City; factories of various kinds will be built, and this will bring in its turn a corresponding increase in the demand for machinery and accessories. The last two

years' trade has on the whole been very satisfactory, and there is every sign of additional prosperity. Competition is very keen indeed, and no trader doing business with the Mexican market can afford to throw away chances, such as is done by firms ignoring clients' wishes and disobeying instructions. Where mistakes are made and continually repeated, advantage of such errors is immediately taken by competitors. I know that British firms have in many instances lost business through not following instructions.

Mexican customs regulations require that besides the Mexican consular invoice, a signed and stamped copy of bill of lading covering goods imported into the Republic of Mexico must be presented at the customs house. This copy is retained by the customs, consequently the consignee must also have a stamped and signed copy, too, for him to obtain delivery of the goods from the carriers. One firm of importers in Mexico City send printed instructions to the above effect with every order they give, and yet in nine cases out of ten British exporters do not comply with the request. In addition to this, it is well to send a copy of the shipper's invoice and a copy of the packing list. The consignee can forward these at once to his customs agent at the port where the goods will enter the Republic; by which means goods so dealt with will receive quicker despatch than would otherwise be the case. The packing list should show marks, countermarks and number of packages; contents of each and the principal material of which article is made; and if plated, with what; gross weight of each package, net weight of each package, or kind of goods in package, legal weight of each package or class of goods; value of each kind of article, total value of package; country in which the goods were manufactured; name of shipper; date of shipment; name of consignee, destination, and the name of the customs broker in whose care freight is consigned. The packing lists or *proforma* invoices should show full marks as they appear on the packages, as the law imposes a penalty for discrepancies between marks on packages and those on custom-house documents. When packages bear marks or numbers other than those which appear on the documents, a fine is imposed. The trade-mark or name and address of the factory, which may be found stamped uniformly on all packages, is not considered as a separate mark. The exact kind of each package, whether box, barrel, bundle, etc., should be shown on the packing list. Duties are assessed on weight of goods, and this is divided into gross weight, legal weight and net weight. Gross weight is the combined weight of all packing, inside and out; legal weight is the weight of goods plus the weight of interior wrappings, cardboard, tin or glass packages in which the goods are contained, but not including the outside protecting case. Net weight is the weight of goods without any packing whatever.

Makers of machine tools would do well to look after the French market. During the past year British houses have introduced these goods into the Bordeaux district, with very good results. Hitherto American and German firms have transacted the bulk of this class of business. There is a capital chance for electrically driven machines, which are very costly and but little understood in the Bordeaux market; but it would be necessary to send an expert to the spot to study local wants. While on this subject, I may add that any United States engineering firm with connections in Switzerland might with profit look after the market that exists there for the sale of electrical appliances, especially for use in hotels. Where power is available proprietors are using it for various domestic purposes, including washing and ironing machines, carbonic-acid presses, electric ventilators, lifts, etc. F. C. C.

London, England.

The "Carmania."

On December 12 a luncheon was given to the representatives of the press on board the Cunard Line's new 2,000 horsepower turbine steamer "Carmania."

The hull and fittings of the "Carmania" are similar to those of the "Caronia," the only material difference being in the engines. The same engine-room space has been reserved, so that had the turbines proven a failure, reciprocating engines could easily be installed without alteration to the hull.

The "Carmania's" length over all is 678 feet; breath, 72 feet; depth to shelter deck, 52 feet; draft loaded, 32 feet; displacement, 29,800 tons; gross tonnage, 20,000. She will carry 12,000 tons dead weight, at a draft of 32 feet.

The boiler equipment is the same as that of the "Caronia," thirteen boilers eight of which are double-ended with six furnaces, and five single-ended with three furnaces in each. Howden's system of forced draft is used throughout. The chief engineer, Mr. Currie—who by the way brought the "Caronia" over on her maiden trip—stated that the boilers steamed easily; A Liverpool Irish gentleman, with a sweat rag tied around his neck, stated that he was better posted on the steaming qualities of the boilers than the Chief, and that "she stamed domd haard."

The main steam pipes are provided with gauze strainers to remove grit and dirt, which might get into the turbines.

She is equipped with three propellers 13 feet diameter, mounted on shafts about 14 inches diameter. The high-pressure turbine is mounted on the center shaft, which is somewhat lower than the two outside shafts. The steam is admitted to this turbine—which is about 8 feet diameter three-stage—at about 180 pounds. From the high-pressure turbine the steam goes to the two low-pressure three-stage turbines, 14 feet diameter, one of which is mounted on each of the outside shafts. The steam enters these at about 90 pounds and exhausts into two ordinary cylindrical condensers—one in either wing of the engine-room. A vacuum of 28 inches is maintained by double-cylinder "dry" air pumps. The circulating pumps are of the usual centrifugal type.

Under way the engine-room is fairly cool, especially so on the lower platforms, but the starting platform—situated above and forward of the turbines—is said to be uncomfortably hot.

The thrust blocks are not in the usual position—abaft the engine—but forward. It is stated that there is little strain on them, as the steam itself takes most of the thrust.

The engines handle very easily, no difficulty being experienced in reversing. The two low-pressure turbines only are used for reversing, being equipped with a section fitted with reversing blades.

Although the "Carmania" encountered heavy head winds and seas in her maiden trip, at no time could the racing of the propellers be felt in the engine-room, and an engineer assured us that it was necessary to look at the indicator to tell when racing did occur.

On the trial trip she made a trifle over 20 knots on the measured mile, which is about a knot better than the "Caronia." So far there is no way of accurately measuring the horse-power of marine turbines, but several experiments intended to reach an approximation have been tried on the "Carmania." Part way along the shaft alley one sees a spidery brass pulley some 3 feet diameter by 3 inches face keyed to the shaft. A triangular projection is fastened across the face of this, in line with the shaft; some 30 or 40 feet further along a similar pulley is fastened to the shaft. An electrical device is so arranged that the projections—which are in line when the shaft is at rest—register their relative positions as the shaft is twisted when the ship is under way. This may give only a very vague approximation, but better than none at all.

Everyone — from the superintendent, Captain Watson, down—is heartily satisfied with the "Carmania's" splendid performance, and we wish her every good fortune.

The Worcester Polytechnic Institute benefits from the will of the late Stephen Salisbury to the extent of $200,000. This, with another $100,000 which he gave only shortly before his death, comes at a time when it is most valuable. The recent rapid growth of the Institute has severely taxed its facilities, but with this new addition it will undoubtedly be able to go on and still further increase its members.

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Sensitive Drillers in England.

Nothing perhaps could be more enlightening as to the different standards of comparison used by Englishmen and Americans in judging of the lightness or the heaviness of machine tools than is to be found in a recent issue of our English contemporary, *The Engineer,* which devotes a supplementary publication to the illustration and description of a large number of drilling machines of various types, many of these types having originated and being quite familiar here. The point we have in mind, however, is the fact that a number of these machines are called "sensitive." There is, for instance, a "sensitive" radial drill, and there are two other machines which are designated by the name "sensitive." The lightest and smallest of these has a drill in its spindle which appears to be not less than an inch in diameter, and the machine looks as though it could drive it, though probably not at full capacity. One of these "sensitive" machines is a radial driller, back-geared, with a worm-gear feed by a hand-wheel, and another has a fixed spindle with a table which is fed up by a system of levers and a foot-pedal, all heavily constructed and counterbalanced by heavy weights.

Now, the term "sensitive," as applied to drilling machines here, originated with the veteran designer, Dwight Slate, of Hartford, who built a very small drill press to use drills up to about ¼ or ⅜ inch, and in order to enable the operator to "feel" the action of the drill as promptly and as accurately as possible, Mr. Slate made the moving parts of his drill as light as possible; he arranged to relieve the spindle of all belt-pull; he counterbalanced the spindle by a clock spring instead of by a weight, and, in fact, made every effort to reduce the weight of the moving parts as much as possible, so that the least increase of resistance to the drill would be quickly felt by the hand of the operator, who could thereby lessen the pressure and save the breaking of the drill. The word has become popular, and Mr. Slate has had a number of imitators here in America, but all of them, so far as we now recall, have recognized the philosophy of the thing and have, in the main, followed Mr. Slate's practice referred to above. Probably the English designers have also understood the point fully, but in working out the design they have evidently had an entirely different standard of comparison by which to decide whether a thing is light and sensitive, or heavy and clumsy. Tool builders and tool users in the two countries will collectively and individually judge for themselves as to which standard is the better. We only call attention to the fact that there is a widely different standard in England from what we have here, and that what they call there a "sensitive" driller would in the shops here be called, if not a heavy driller, then, at any rate, anything but "sensitive."

Still Believes the Earth is Flat.

The hopelessness of convincing every living being of the truth of any proposition is again illustrated by what one Aurin F. Hill, of Boston, says about an item that appeared in a recent issue of the *Springfield* (Mass.) *Republican,* to the effect that Springfield is 65.8 feet above sea level. Mr. Hill says regarding this:

"Springfield is about 100 miles from Boston. Is this grade at Springfield correct? If the earth were a globe 8,000 miles in diameter, Springfield ought to be about 6,666 above or below Boston. Is it? Can our engineers survey a level and straight line—a horizontal line—from Boston to Springfield? I think they can. I think they did it; and by their works prove that this earth is a plane and stands fast. They prove by their works that water is level—straight on its surface. Consider the curvature on a globe 8,000 miles in diameter at the center circle; also at what we call 42 degrees north latitude, going east or west. We are on a plane that stands fast."

It will be news to engineers that a level line is a straight line; and if by considering the curvature of the earth, Springfield is found to be something over 6,000 feet above Boston, then in the same way we should find that Boston was about 6,000 feet above Springfield, which discovery we imagine would be somewhat confusing. The dictum to the effect that "this earth is a plane and stands fast," when uttered by a man who exhibits so much and such comprehensive ignorance of the elementary principles of levelling, does not amount to very much.

The Patent-Medicine Graft.

Wage-earners who have families to look after and who find it necessary to economize in every way possible are apt to be particularly the victims of the patent-medicine swindlers, and we consider that scarcely any more important work is now being done in behalf of the public than is the publication in *Collier's* and the *Ladies' Home Journal* of exposures of the composition of many of the well-known patented nostrums and an account of the methods of their promoters in forcing them upon a confiding public.

It is demonstrated by these exposures that decoctions consisting of 99 per cent. water, with the other 1 per cent. injurious poisons, which no intelligent person would think of taking into his system, are able to command just as high-sounding testimonials and certificates from alleged physicians, hospitals, public institutions, etc., as would be the case were the article really possessed of some merit; while mixtures consisting largely of the cheapest grade of whisky and sold at a price four times its value, are taken by many who are the real or imaginary victims of diseases which it is claimed these cheap decoctions will cure,

but which really cure nothing, but only stimulate; the net result being that the victim is not only swindled out of his money, but injured physically, and perhaps even killed.

It would be a good thing if the entire horde of patent-medicine vendors were driven out of business. Even those who think they are carrying on an honest business—and they are rare—are in reality tempting people to undertake to diagnose and to treat their own ailments, which is always an unwise thing for them to do.

It is well to remember that the advertising matter sent out by patent-medicine vendors reflects only the ability, or the dishonesty and rascality of the advertiser or vendor, and usually has no relation whatever to the actual merit of the thing advertised.

A disgraceful feature of the exposure referred to is the showing made of the extent to which the daily and weekly newspapers published throughout the country are under the influence of the vendors of these worthless and injurious nostrums. In this connection fac simile reproductions of advertising contracts made by patent-medicine swindlers with newspapers have been published, the terms of these contracts showing plainly the real meaning of editorials that may appear in such papers designed to influence legislation that may be intended to protect the health and the purses of the public. The whole showing is of a particularly dirty and miserable business, and a plain tramp is the embodiment of respectability compared with those who carry it on.

We are far behind most of the nations of Europe in respect to laws which will protect the public from swindlers of this sort, and it is to be hoped that adequate laws will be speedily enacted and enforced. In the meantime, the intelligence of the people must protect them from this peculiarly despicable and rascally form of swindling.

The Electrical Exhibition at Madison Square Garden.

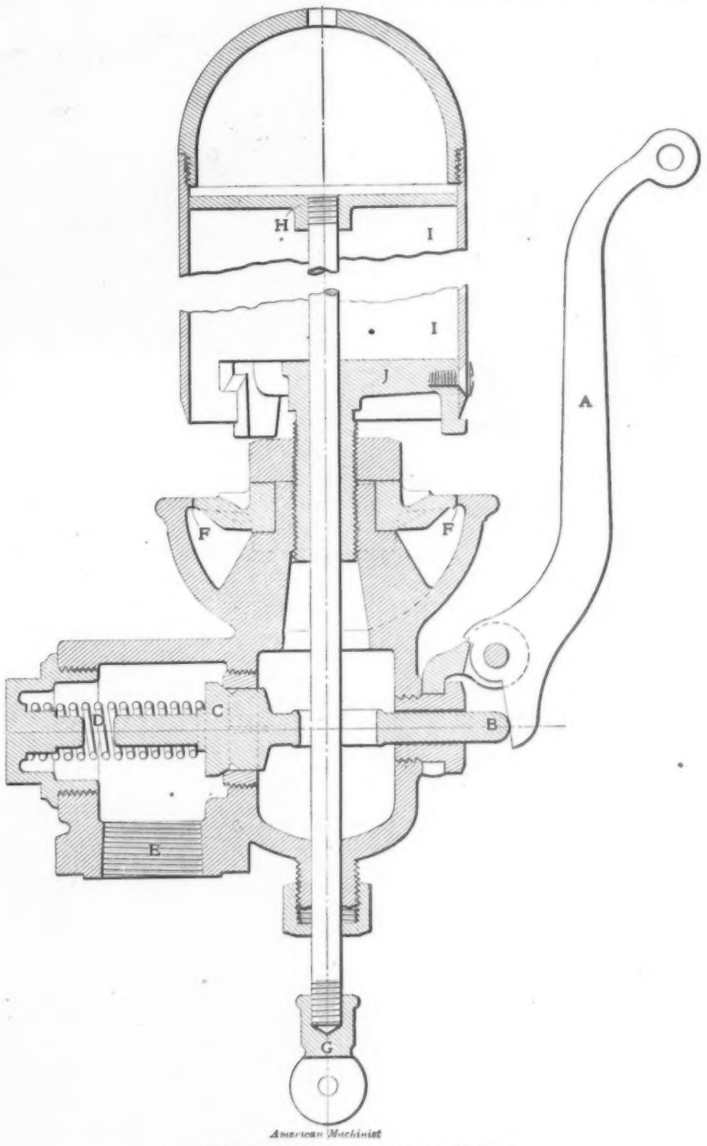
The electrical show this year is a disappointment. None of the large manufacturers of electrical machinery are represented, there being but a single exhibit of dynamo machinery, consisting of two 20 horse-power machines. There is a good display of medical apparatus, and the phonograph, of course, is in constant evidence. The De Forest wireless telegraph is well represented, and there are any number of novelties, including some that have no discoverable place in an electrical show. The demonstrations of the effects of high-frequency currents in the lecture hall are by far the most striking and interesting feature of the exhibition.

It seems to be pretty well settled that not many people will pay admission to see what is, after all, an advertising show or joint sales room.

New Tools and Machine Shop Appliances.

A COMBINATION FIRE-ALARM WHISTLE.

The illustration shows a whistle which is provided with a piston to be moved up or down within the bell, thus changing the length and the tone. When the piston is stationary, the whistle gives but one tone. Steam is admitted at *E*. On pulling the cord attached to the lever *A*, the yoke *B* opens the valve *C*, permitting the steam to escape through the openings *F* and impinge on the feather edge of the bell *I*.



A COMBINATION FIRE-ALARM WHISTLE.

On releasing the cord, the spring *D* and the steam pressure return the valve *C* to its seat. A suitable lever and rope are attached to the piston-rod *G* for operating the piston *H* to alter the tone.

At its upper end, the bell *I* is dome-shaped, and its lower end is supported by a three-arm spider *J*, the stem of which is adjustably screwed into the whistle base and fastened by a lock-nut. This construction keeps the lower edge of the bell always in line with the slots *F* in the base, through which the steam escapes, thereby insuring best results by the production of a perfectly clear and loud tone.

This whistle is made by the Lunkenheimer Company, Cincinnati, Ohio.

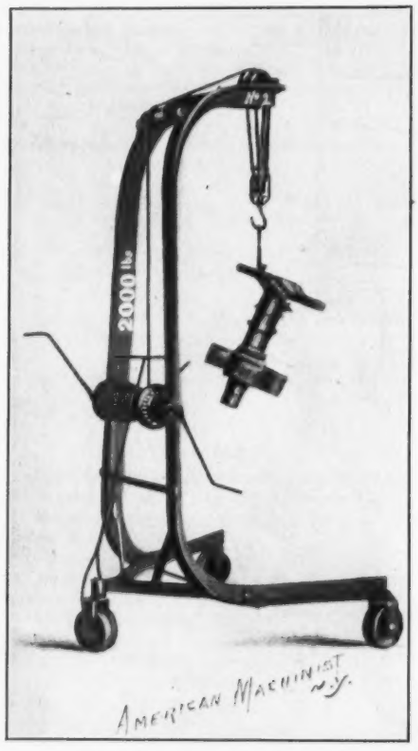
NEW TOOLS—PORTABLE GASOLENE-ENGINE-DRIVEN AIR COMPRESSOR.

The Ingersoll-Rand Company has recently filled an order from the Panama Canal Commission for two interesting portable air-compressor plants. The compressors are geared to gasolene engines, the combination being mounted on a truck for ready transportation. The connection is by gears and a friction clutch, which, being disengaged, permits the engine to be started without load. The truck also carries a tank of cooling water, which is arranged on the cooling-tower principle to permit the water to be used repeatedly.

The machines are intended for the operation of pneumatic tools, in general repair work and in erecting heavy plants of machinery. The engines have a capacity of 16 horse-power.

PORTABLE CRANE AND HOIST.

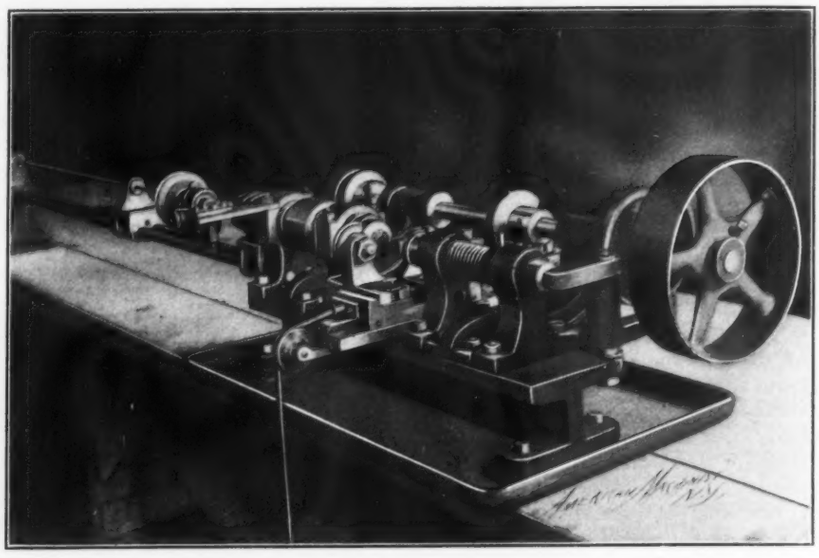
The portable crane and hoist of which a half-tone illustration is here presented, is remarkable for its light weight in comparison with the load it is capable of carrying. This feature is attained by making the frame of two pieces of angle-steel, continuous from top to bottom, bent to the necessary shape and tied together. The bottom frame is completed by extensions from the horizontal portions of the angles, formed of rectangular section and meeting above the castor or swiveling wheel (this wheel is guided by the



PORTABLE CRANE AND HOIST.

pulling handle seen swung back against the frame). The other two carrying wheels have fixed bearings. The crossties and diagonal braces of the frame can be seen in the picture. All the bearings, except those for the hoisting-drum shaft, but including those of the carrying wheels, are ball-bearing. This hoist is made in six sizes, having capacities from 1,000 to 6,000 pounds. The No. 1 hoist, capacity 1,000 pounds, weighs 260 pounds; the No. 2, capacity 2,000 pounds, weighs 340 pounds; the No. 3, capacity 3,000 pounds, weighs 425 pounds. The standard height of the machine is 8 feet, but it is built of any height up to 10 feet. The overhang is 2 feet, and the maximum height of hoist is 6¾ feet. The width of bed from wheel to wheel is 4 feet; the wheels are 7½ inches diameter and 3 inches face. The machines are furnished with best quality manila rope, "ship grade," and a steel pulley block; at a small additional cost, an adjustable grab chain having two double hooks for handling cases, casks, barrels, etc., can be furnished.

The advantages of such a machine as this are apparent. It can be taken all around the shop, and one man can handle armatures, or lift large heavy castings on to or off from machine tools, and it can in general perform many of the duties of an overhead crane, or a lorry track, saving the large cost of installing the latter equipments. The portable hoist is made by Wm. S. Nicholls, 253 Broadway, New York.



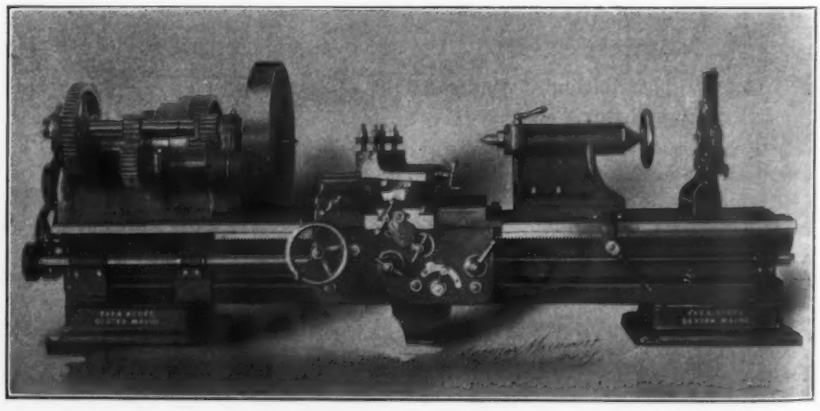
AUTOMATIC SCREW MACHINE.

ENGINE LATHE.

The illustration shows a 38-inch triple-geared engine lathe. This tool has a back-gear ratio of 12½ to 1 and triple-gear ratio of 40 to 1. It swings 34 inches over the carriage, and, as indicated above, 38 inches over the ways. The latter are of "V" form and provide ample bearing surfaces for the gibbed carriage. The spindle has a front bearing 6¼ inches diameter by 10½ inches long, a rear bearing 4½x7 inches, and runs in bronze boxes. The hole through the spindle is 3 1-16 inches diameter, and at the mouth No. 6 Morse taper. The driving-cone steps range in diameters from 8 to 22 inches and are 4 3-8 inches wide. The apron is fitted to the carriage by tongue and groove joint. The feed-change gears provide for cutting threads from 1 to 16 per inch. The compound rest has power-feed over 10½ inches, for convenience in angular work. The countershaft friction pulleys are 20x6 inches, and the counter is intended to run at 100 turns per minute. With 10-foot bed the lathe weighs 13,000 pounds. It is built by Fay & Scott, Dexter, Maine.

AUTOMATIC SCREW MACHINE.

This machine is of course adapted to the manufacture of a variety of small parts requiring such operations as forming, drilling, threading, etc., as well as to the production of screws, and will take stock up to ½ inch diameter. The mechanism is of simple character, all cams being carried by the driving shaft at the rear, and in place of a turret a single spindle, with spring return, is provided for carrying a drill, die, or other tool. The feed of the

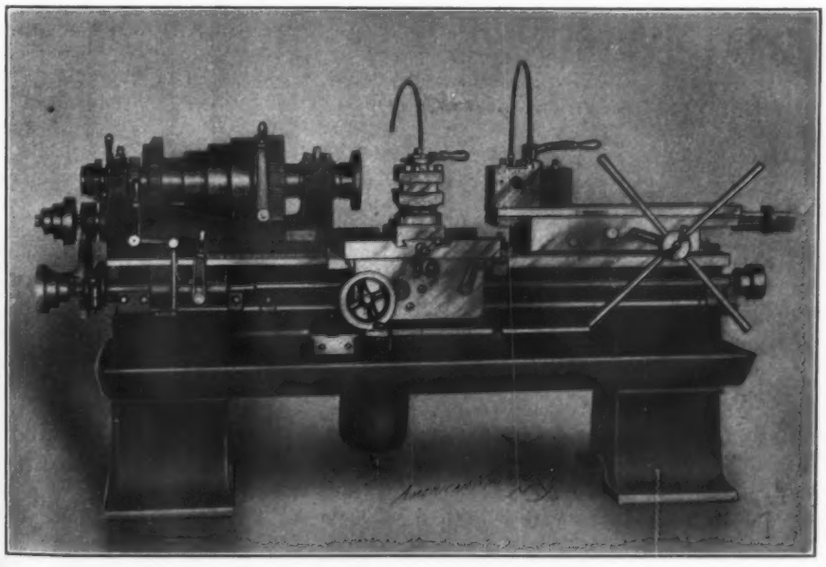


ENGINE LATHE.

stock is by means of a sleeve on the bar, which sleeve is drawn forward by a cord and weight when the spring chuck is opened, and the return movement of the cross-slide, which carries forming and cut-off tools, is also by cord and weight. The rate of feed for cross-slide and end-cutting tools is in accordance with the pitch of the cams on the rear shaft; and the positions of the various tools are readily varied by means of adjusting screws. For threading, an opening die is used which is fitted with a pair of spring jaws, to the ends of which the chasers are attached. An adjustable collar holds the the die closed until at a predetermined point in the forward movement it encounters a stop and allows the chasers to open. The maker of the machine is the Matchless Cigar Lighter Manufacturing Company, 16 John street, New York city.

20-INCH UNIVERSAL TURRET LATHE.

This lathe will handle bar stock, forgings and castings. It has a double back-geared headstock, with gear ratios of 6 to 1 and 10½ to 1, the ratio being changed by means of a step-gear on the spindle, and a friction drive is provided to permit instant change from slow to fast speeds, or *vice versa*. The spindle has a 2 1-16 inch hole clear through for bar stock, a No. 6 Morse taper hole at the end, and runs in bronze bearings; its front bearing is 3½ inches diameter by 5 inches long, and the rear bearing 2⅝x3¼ inches. The four steps of the driving cone range in diameter from 6 to 11½ inches, and are 3⅛ inches wide. The carriage has automatic stop and a reverse feed, and the threads



20-INCH UNIVERSAL TURRET LATHE.

cut range from 2 to 24 per inch. The feed drive is either by belt or gears, and the change from one to the other is instantly made by means of a clutch. The carriage has bearings of ample length on the "V's," and is securely gibbed, and the apron is tongued is place. The turret slide has a feed of 16 inches by power. The turret measures across flats 11 inches, and the holes are 1¾ inches diameter. An oil pump supplies lubricant through the center stem of this turret as well as over the carriage. A turret tool-post, mounted on the carriage in place of the usual block, carries four tools, which are brought into position by a single movement of the revolving lever. The head swings over the bed 20 inches, and over the carriage 14 inches. The countershaft has pulleys 12x4 inches, and runs at 125 turns per minute. The weight of the machine, with 8-foot bed, is 4,700 pounds. The builders are Fay & Scott, Dexter, Maine.

A VALVE.

The illustrations show a valve invented by George Rothenbucher, 976 Glenmore avenue, Brooklyn, New York, for which he has recently applied for a patent. The exterior has the appearance of a regulation globe valve, but the interior resembles a cock in that it has a tapered plug and seat. It further resembles a cock, as it requires but a quarter turn to open or close it.

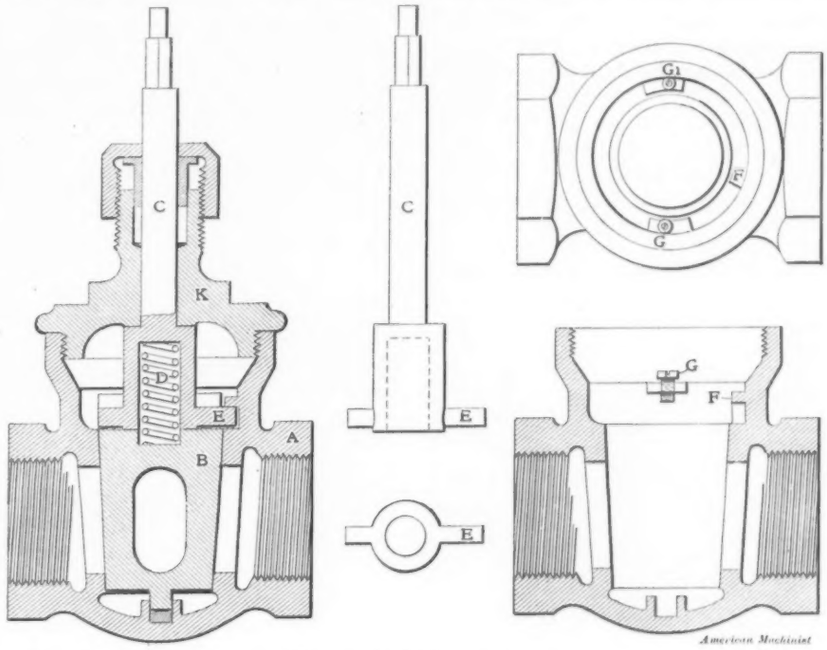


FIG. 1. SECTION OF VALVE.

Referring to Fig. 1, *A* is the body, *B* is the plug, which it will be observed does not extend through the bottom of the body. *C* is the spindle, which has no thread cut on it. The lower end of the spindle *C* is bored to receive the spring *D*, which maintains a uniform pressure at all times on the plug *B*, forcing it to seat. The lower end of the spindle *C* is provided with two wings which fit easily into the two slots between the lugs *H* on the top of the plug *B*. One of these wings *E* is longer than the other, and coming in contact with the lugs *F* and *G1* in the

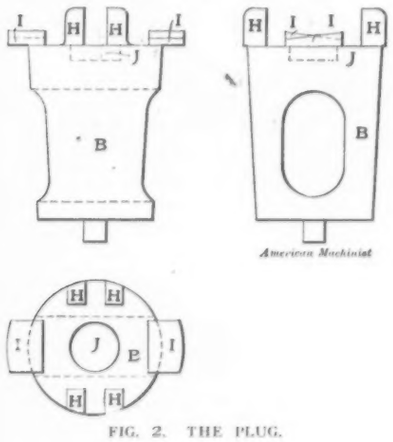


FIG. 2. THE PLUG.

body *A* of the valve, determines the rotary travel of the plug. By referring to Fig. 2, it will be seen that there are two wedge-like lugs *I* on the plug *B*. When the valve is shut these lugs wedge themselves—and the plug *B* as well—under the two screws *G* and *G*1 in the body *A*. When in this position the cap *K*, with its spindle *C*, may be removed and a blank cap, with no spindle in it, screwed in place, insuring that the valve will not be tampered with.

The valve is for use with steam, gas, water, etc., and has been successfully tested up to 350 pounds pressure.

MACHINISTS' AND PATTERNMAKERS' PROTRACTOR.

The accompanying illustrations show a protractor which has been patented by Abraham Anderson, of Moline, Ill. Fig. I shows the instrument as arranged for

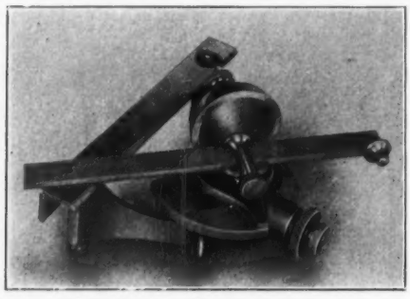


FIG. I. PROTRACTOR ARRANGED FOR READING ANGLES.

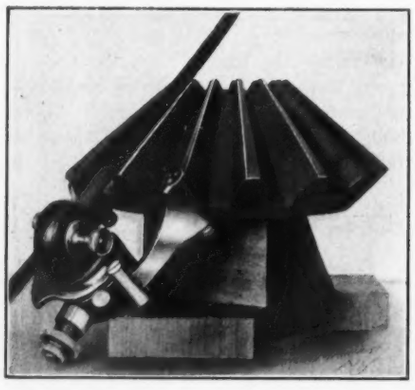


FIG. 2. PROTRACTOR ARRANGED FOR LAYING OUT BEVEL GEARS.

reading or scribing angles between two straight-edges, the angle being read from the graduations in the base. The straight-edge, which forms the base of the instrument as set up in Fig. 1, may be removed from the arms which carry it, leaving the instrument in shape for application to the edge of a circular piece, as, for example, a bevel gear pattern as shown in Fig. 2. The arms are swiveled in the base as shown in Fig. 3, and by the nurled heads at the left they may be closed in or spread apart as desired, and be clamped in the desired position. With the base straight-edge removed the instrument may obviously be used as a center square. The end of the blade carries a marking disk, and by loosening the clamping screw it may be drawn through its clamp and thus draw radial lines or curved surfaces, such as that shown in Fig. 4.

Improvement and Standardization of Materials for Automobiles.

The Association of Licensed Automobile Manufacturers is to have an investigation conducted abroad for the purpose of study-

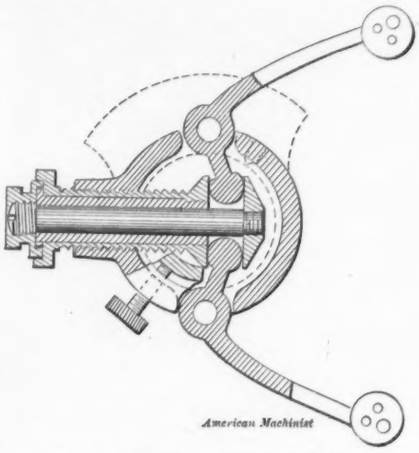


FIG. 3. INTERIOR OF PROTRACTOR.

ing experimental alloys with a view to keeping posted as to the developments in materials for automobile construction. The mechanical branch of the association is working for standardization, and at its laboratory in Hartford samples of steel are tested and worked in various ways to determine their quality and fitness. Speaking of steels, Henry Souther, the engineer

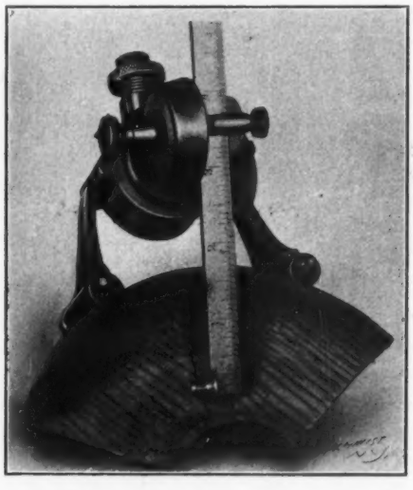


FIG. 4. RULING RADIAL LINES ON CURVED SURFACES.

in charge of this laboratory, states: "There are four grades. Low carbon steel will show a tensile strength of 60,000 pounds with an elastic limit of 40,000 pounds. The next grade, high-class carbon, shows 85,000 pounds tensile strength and 55,000 pounds elastic limit. Nickel steel annealed gives 85,000 pounds tensile strength and 60,000 pounds elastic limit. With special treatment its showing will be 100,000 and 70,000, respectively. The chrome nickel steels are the highest grades and will test at 90,000 and 65,000 pounds annealed, and 250,000 and 150,000 with special heat treatment. The maximum commercial limit that has been reached in chrome nickel steel is 275,000 pounds tensile strength and 183,000 elastic limit."

A Cutter Bar For Internal Keyseating.

The illustrations show a cutter bar and cutters for internal keyseating which has

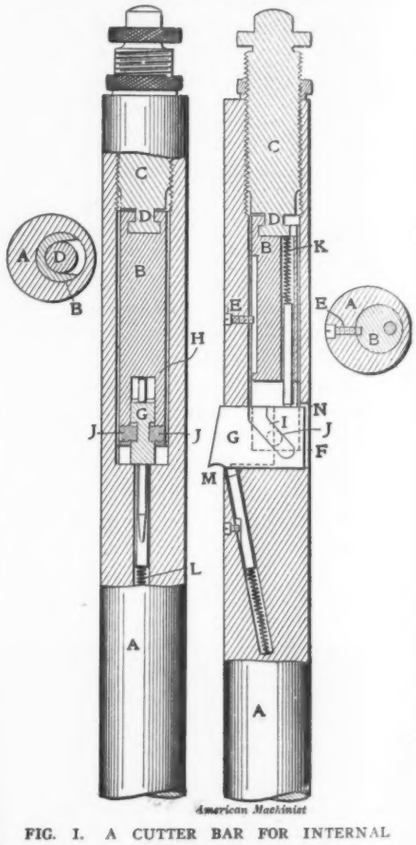


FIG. 1. A CUTTER BAR FOR INTERNAL KEYSEATING.

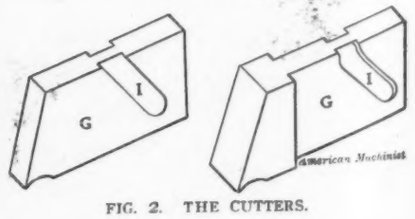


FIG. 2. THE CUTTERS.

recently been patented by Ivor W. Jones, 917 Second avenue, Birmingham, Alabama.

It will be noted that the bar below the cutter is solid—with the exception of the hole for the small spring *L*—consequently there is no place for chips or dust to lodge and impair the efficiency of the bar.

Owing to the form of the feeding mechanism, there is very little strain on it during the cutting stroke, and being

above the cutter, is out of the way of chips.

The bar *A*, Fig. 1, is bored to receive the feed-pin *B* and threaded to accommodate the feed-screw *C*. The shoulder *D*—on the end of the feed-screw *C*—permits *C* to advance or retract *B* without turning it. The screw *E*, working in a spline in *B*, prevents it from turning in *A*, as does also the cutter *G*.

The lower end of the bore in the bar *A* for the feed-pin *B* is slotted across at *F* for the cutter *G*. The lower end of the feed-pin *B* is also slotted to straddle the cutter *G*, as shown at *H*, Fig. 1. The cutter *G* is provided with slanting channels *I*, in which two small pins *J*, secured in the feed-pin B, work. These pins, when the feed-pin *B* is forced downward by the feed-screw *C*, slide in the slanting slots *I* and feed the cutter *G* forward to its work. On the return stroke of the bar *A*, the cutter *G*, pivoted on the two pins *J*, rocks sufficiently for relief, the springs *K* and *L* returning it to cutting position at the end of the return stroke. The cutter has a small amount of clearance at *M* and *N* to permit rocking. At Fig. 2 two shapes of cutters are shown, the one with the enlarged head being for wide keyways.

Systematic Instruction in Automobile Design and Management.

During the recent meeting of the American Society of Mechanical Engineers in New York, they were invited to visit the New York School of Automobile Engineering, where many of them saw things of considerable interest to them. Concerning this school, *The Horseless Age*, of New York, recently published the following interview with Prof. C. E. Lucke, of Columbia University:

The managers of the New York School of Automobile Engineering have secured quarters and expect to begin work in the near future. The leading object of the school is to enable automobile owners to secure the proper instruction for themselves or properly schooled drivers for their cars. A school of instruction for drivers is a necessary adjunct to the automobile business. Many sales have been lost and many machines returned because of accidents to machinery or persons, and even loss of life, due to the negligence and incapacity of drivers. The second object of the school is a broader one. These drivers of motor cars have in their charge not only valuable property, but property of a sort that may endanger life. The industry is now passing through a stage which the locomotive went through at an earlier date, the outcome of which was that no man was allowed to run a machine unless licensed. Fines and speed laws are ineffective, but if a license were required it would be a most effective preventive of accidents.

As soon as the proper time appears for it, there will be carried out a course of instruction for the education of designers and builders of automobiles. This part of the work will be the engineering course properly so called, and is not started at the present time simply because it is felt that there is no present insistent demand for it.

The students will be drawn from two classes of society. There will be men of comparatively little education who wish to simply fit themselves to operate machines for owners, and whose relation to the owners will be the same as that of an engineer to the railroad. These will form one class, and owners who desire to run their own machines, or to know enough about them to understand what their chauffeurs are talking about, will form the other.

For the class of owners the instruction will be given as seems most convenient, and this class will be subjected to no rigid discipline, except if any members desire a certificate, in which case they will be required to conform to exactly the same rules as the other class.

The chauffeur class will furnish the larger number of students, and they will only be admitted to the school under certain conditions. They must be men of reasonable intelligence, able to write a letter, read a road map and understand municipal ordinances after having read them through; they must also know something of arithmetic. These checks will all be in the form of an entrance examination. Evidence will be required that the applicant's character is satisfactory.

Regular students of the chauffeur class will be put through a rigid course of instruction extending over a certain period not yet fixed. The plan of instruction will be so laid out that a man passing all the tests must, of necessity, be competent. The students will have to pass examinations from time to time, and the penalty for failure will be expulsion from the school. The fact that the party in question is a pretty good chauffeur is not sufficient with us.

No school has ever been laid out to do this work in such a serious way. The original data for the scheme of instruction will be furnished us by various trade and technical schools. Instructors will keep close watch of the students to judge the effect of our methods on them, and the methods will then be modified, as suggested by the observations, regardless of any man's prejudices.

The instruction will be given under ten headings, as follows:

First—Classroom instruction by lectures and recitation.

Second—Instruction on emergency repairs, in a shop, including simple forge work, vise work, chipping, filing, sawing, drilling and tapping, simple turning, grinding, soldering, sheet-metal work, pipe filling, etc.

Third—Transmission of power, speed change gears, reversing gears, differential gears, brakes, speed counters and revolution counters, tires and tire repairs.

Fourth—Ignition systems, direct current, alternating current, dynamos and all the different systems of jump and touch spark and accessories.

Fifth—Instruction on the use and testing of fuel oils and lamp materials. This will include gasolene, kerosene, alcohol, etc., as used in lamps, carbureters and burners; acetylene, calcium carbide as used in lamps; lubricating oils for cylinder crank case and for bearings. With this group of apparatus will be arranged also equipment of fans, radiators, pumps, tanks, etc., used for circulating system of engines.

Sixth—All work on engines and power generators as isolated from the rest of machinery. Gasolene and steam engines will be so set up as to enable brake tests to be made and to show effect on brake horsepower of variation in speed, carbureter adjustment, throttle adjustment, lubrication, water-jacket temperature and muffler back pressure.

Seventh—Instruction on a complete machine set on rollers so that the operators may be taught to control the machine without being worried with speed limits and road rules. They will learn how to start and stop, change speed, how to operate brakes and everything else about it except steering. This also enables tests of horsepower available at wheels to be made.

Eighth—Instruction on a complete machine also, but of a different sort. Here the man will be taught to take the machine from a state of completion to a complete state of separation and put it together again, properly adjusted. This will involve the use of various tools not used in shop instruction, such as jacks, hoists, wrenches, etc.

Ninth—Instruction on a complete machine on a track, where all steering and control problems will be encountered, but at the same time under such conditions as will not worry the operator. No road laws to be kept in mind yet. The Morris Park race track has been secured for this instruction.

Tenth—Instructions on complete machines, on the road, under usual conditions. The man will be required to operate cars for a certain length of time on city and highway roads, both by day and by night, in crowded streets.

After this series of instructions the work of the instructors is complete, and all that is needed for the chauffeur is practice. When he is competent the instructors of the school, if they have found him a safe man and of good character, will issue a certificate to him.

Instruction will be given by six permanent instructors, under my own direction.

Besides the regular course, specialists and experts will address the students of the institution. A lawyer will be secured to explain laws and ordinances. A tire man will explain tire problems, etc. The school will also have a library and con-

ference room, where all literature pertaining to automobiles, past and present, will be kept, including drawings, blueprints, catalogues and trade literature, etc., also valuable for study. These will be permanently filed for reference by anyone.

Another phase of automobile work never heretofore carried out systematically will be attempted by the school. A record will be kept of all automobile troubles and breakdowns. This information will be obtained from the owners of the cars, who will be invited to send to the school records of all accidents that have happened to their machines, which will be tabulated and classified by the instructors. In this way it is expected to build up a body of information that will assist in the perfection of the designs of the future.

It will be possible, by reason of equipment, to make tests on engines or complete vehicles for owners or builders.

New Publications.

"Physics." By C. R. Mann and G. R. Twiss. 453 5x7½-inch pages, with 237 illustrations. Scott Foresman & Company, Chicago. Price, $1.25.

It is a long time since we have examined a school text-book on physics that has interested and impressed us as this has done. The recent new discoveries in radio-activity and the resulting speculations regarding the constitution of matter have made the rewriting of text-books on this subject necessary, and in the present case this has been done with a freshness of illustration and treatment that reminds one of the writings of Tyndall. The book sets out to interest the student by treating of the common phenomena about him. The first chapter treats of motion, velocity and acceleration, and its first paragraph takes the motion of a railroad train as an illustration of motion, and from the movement of the train the conceptions of velocity and acceleration are obtained. Illustrations from every-day life and from engineering subjects abound throughout the book. Thus, the pressure-volume diagram having been explained, the indicator is introduced as an illustration of its use. The early history of science is presented. live interest in it being imparted by accounts of the epoch-making discoveries of the past, particular effort being made to describe the atmosphere of the time and thus to present the mental attitudes of the pioneers in discovery. The metric system of weights and measures is used throughout the book.

"Notes on Mechanical Drawing." By Horace D. Fry. 55 6x9-inch pages, with 32 illustrations and 16 full-page plates. The University of Pennsylvania, Philadelphia.

This manual, which has been prepared for the students of the University of Pennsylvania, is devoted chiefly to setting forth the various conventions which the student must learn, and which form an appropriate subject for such a manual. The conventions used are sensible and such as are used in construction drawings. The book has obviously been prepared by one whose knowledge of drawing was not all acquired at school.

"The Effect of Preparations Applied to Belts." By Thos. Farmer, Jr., and C. W. Evans. 71 4½x7-inch pages. Cling Surface Company, Buffalo, N. Y.

This pamphlet is a republication of a thesis by two students of Cornell University, and gives the results of an extended series of tests by the belt-testing apparatus originally designed by Wilfred Lewis, and used in his widely known belt tests made for William Sellers & Co. The preparations tested were neatsfoot oil, Cling Surface and two others of which the names are not disclosed. The tests were painstaking and thorough, and the pamphlet gives results of value and importance to belt users.

"Report of the Proceedings of the Thirteenth Annual Convention of the International Association of Railroad Master Blacksmiths' Association." 164 6x 8½-inch pages. Published by the association.

The Railroad Master Blacksmiths' Association is doing good work, and its annual volume of proceedings always contains matter of interest and value. Among the more important discussions included in the present volume are those on forging motion work, repairing locomotive frames, the use of forging machines and bull-dozers, high-speed steel, oil furnaces, and tools and formers for steam hammers.

"The Mechanical World Pocket Diary and Year Book for 1906." 302 4x6-inch pages, with numerous illustrations and tables. The *Mechanical World,* London and Manchester. Price, 6 pence.

The new edition of this well-known pocket book contains more than the usual amount of new matter. The steam turbine, ice machinery and manufacture and speeds and feeds for tools of high-speed steel are represented by new chapters, while additions have been made to the tables of factors of evaporation and to the sections on gas and oil engines, screw threads, crane chains and others. The book gives more for the price than any publication of which we have knowledge.

"Elementary Descriptive Geometry." By C. H. McLeod. 118 5x8-inch pages, with 85 illustrations. John Wiley & Sons, New York; Chapman & Hall, London. Price $1.50.

This book may be called a combination of pure and applied descriptive geometry. Following and growing out of the more general problems and constructions of descriptive geometry proper, we find the applications of these constructions to projections, intersections and the development of surfaces, these applications forming the major portion of the book. The result is extremely satisfactory. Moreover, the book is of moderate size, and, in view of the crowded state of the curriculum of all engineering schools, it will no doubt be well received as a text-book. We regret to note, however, that the book uses the first angle of projection throughout; in which it follows the universal practice of books on pure descriptive geometry. It would, no doubt, be looked upon as almost iconoclastic to use the third angle in teaching that subject, but there is really nothing to be said against it, and its use from the start would save the student from the necessity of forming new conceptions of the subject when he begins his work on construction drawings. Apart from this, the book appears to us to be an almost ideal presentation of the subject.

"Gas, Gasolene and Oil Engines." By Gardner D. Hiscox. Fifteenth edition. 442 6x9-inch pages, with 351 illustrations. Norman W. Henley Publishing Company, New York. Price $2.50.

The demand for this book, which is described on the title page as "a new book from cover to cover entirely reset, revised and enlarged," is sufficiently shown by the number of editions through which it has gone. In it is collected a large number of illustrations of the leading features of construction of leading types of engines. Much attention is given to automobile, launch and modern high power producer gas engines, as well as to producer gas and producers, of which many illustrations are given. The book concludes with a list of American patents and of gas, gasolene and oil engine builders.

"Modern Turbine Practice and Water Power Plants." By J. W. Thurso. 244 6x9-inch pages, with 88 illustrations. D. Van Nostrand Company, New York. Price, $4.

The great and growing development of electric power plants driven by turbines makes a comprehensive presentation of turbine practice, which this book is, a very timely contribution to engineering literature. The book opens with a chapter on Turbine Practice in Europe, and follows this with a chapter on Turbine Practice in America, and the comparison which is thus drawn is in fact continued through the entire book. The author's opinions of American practice are not complimentary, in fact he distinctly calls the art of turbine construction in this country "backward"—not that he condemns American turbines *in toto*, but that he considers turbine building here to be in a rut established by the testing flumes at Lowell and Holyoke, where the greatest available head is but 18 feet. The practice of testing turbines at Holyoke has led turbine makers to bend every energy to the production of machines that would give high results at that flume, contentedly remaining in ignorance

of their performance under other conditions. To such an extent has this gone that so far as the author is aware, results of reliable tests of American turbines working under heads much greater than 40 feet have never been published. The result is that the adaptation of turbines to widely varying conditions, that is, their construction as a piece of engineering as distinguished from manufacture, is almost unknown here. To such an extent has this gone that the author tells us he has "found it practically impossible to induce [American] builders to bid on anything else except the American standard type. even when they were furnished with complete drawings and relieved of all responsibility in regard to the performance of the design," the effort of the manufacturer being to compel the design of the entire power-house plant to conform to his stock patterns. That the author's opinions are not based on prejudice is shown by his statement "for low heads the writer considers the American turbine as the best type." He gives the palm for progressive turbine building to Switzerland.

"Modern Engines and Power Generators." By Rankin Kennedy. Five volumes, 7½ x10-inch pages, profusely illustrated. The Caxton Publishing Company, London. D. Van Nostrand Company, New York.

This work is of an encyclopedic character and includes windmills, water-pressure engines, water and steam turbines, injectors, centrifugal pumps and fans, hot-air, gas, steam and oil engines, including automobile engines. It is both descriptive and analytical, an outline of the theory being given with each motor described. The descriptions go into details and accessories to a considerable extent, and the entire work forms a mine of information.

"Bulletin de la Société d'Encouragement pour l'Industrie Nationale." Paris: Siège de la Société, Rue de Rennes, 44. Vol. 107, No. 8, for August, September and October, 1905.

The bulletins of this society cover a broad field, and contain much information; they are always well printed on good paper and usually very well illustrated. The collection before us contains, along with other things, some articles of interest to those concerned with machine design and construction. The first of these is an account of meetings held April 4 and June 22, 1905, to discuss the extension of the international system of screw threads to screws of less diameter than 6 millimeters (down to 1 mm.). This article is illustrated with diagrams. It is followed by a 39-page article by M. Codron, on "Experiences with the Work of Machine Tools," describing experiments in drilling, and containing numerous diagrams, and illustrations of twist drills (as affected by the tests) and drillings, tables of power required, etc.

In connection with the discussion at the recent meeting of the American Society of Mechanical Engineers, a 26-page article on ball bearings, by M. C. Gegauff, will be apropos. This article was previously published in the *Bulletin de la Société Industrielle de Mulhouse*, and contains over forty illustrations, diagrams and tables, and much information regarding ball bearings and experiments therewith.

M. Demozay, in an article occupying 38 pages and abounding in plotted curves, describes some experiments to determine the effect of various conditions on the temper of steel.

MM. Ch. Fremont and F. Osmond present a study of corrosion of boiler plates, in view of the light thrown on the subject by microphotography, and based upon observations made upon locomotive boilers on the Western Railway of France.

Personal.

The address is desired of Stephen P. Lathrop, who was a manufacturer of Lathrop governors at Montclair, N. J. Will he, or any friend knowing his address, kindly send it to the editor?

We are always glad to receive information suitable for publication under this head, and will be obliged to our readers for sending it to the editor, whether it pertains to the doings of the sender or to another.

Ralph M. Warfield (Worcester Polytechnic Institute, '01), who has been engaged at the Brooklyn Navy Yard, has accepted a position as assistant professor of civil engineering at the University of Vermont.

C. V. Raper has resigned his position of engineer with the Lodge & Shipley Company, and accepted a position with the National Automatic Tool Company, of Dayton, O. Mr. Raper left for Europe on December 2, on the business of the National Automatic Tool Company.

Robert P. King has terminated his connection with the Smoke Prevention Department of the city of Indianapolis, and will resume the practice of consulting and erecting engineer with the firm of Brossmann & King, at their offices in the Lemcke Building, Indianapolis.

Prof. C. M. Allen, of the Worcester Polytechnic Institute, has received a patent for a "Flow Register," or instrument for registering the amount of water used by a turbine water wheel. The instrument makes allowance for the position of the gate and for the head of water under which it is operating.

Dr. Henry S. Pritchett, formerly president of the Massachusetts Institute of Technology, will on January 1 commence his work as president of the Carnegie Foundation in the offices of the Carnegie Fund at 542 and 544 Fifth avenue. Dr. Pritchett is a native of Missouri and is a graduate of the University of Munich. Before becoming president of the M. I. T., five years ago, he was superintendent of the United States Coast Survey, stationed at Washington. The Carnegie Foundation was established by Mr. Carnegie with a $10,000,000 gift in order to aid teachers and professors and to extend larger opportunities for research work.

Obituary.

William H. Davenport, aged seventy-eight years, the founder of the W. H. Davenport Firearms Company, of Norwich, Conn., died December 12 at his home in that city. He was well known in the firearms trade. Pneumonia was the cause of his death.

General Herman Haupt, a veteran of the Civil War, a noted railroad man and engineer, and the oldest graduate of the Military Academy at West Point, died suddenly, December 14, of heart disease on a Pennsylvania Railroad train between Jersey City and Newark. He was born in Philadelphia in 1815.

Manufacturers.

The Utica (N. Y.) Pipe Foundry will enlarge its plant.

Fire destroyed the foundry of Doherty Brothers, Lowell, Mass.

The Dayton (O) Pneumatic Tool Company is seeking another location.

The Public Service Company will erect a gas plant at St. Cloud, Minn.

The Walker Foundry Company, Erie, Pa., will erect an addition to its plant.

The Sioux City (Ia.) Foundry Company will erect a new plant, increasing its output.

The E. R. Merrell Spring Company, Jersey City, N. J., is putting up a new factory.

The King Stove & Range Company, Sheffield, Ala., is building an addition to its foundry.

The New Orleans (La.) Cold Storage Company will build a four-story addition to its plant.

The Torrington (Conn.) Manufacturing Company has let contract for a new boiler-house.

The Lally Patent Column Company, Waltham, Mass., is erecting a factory at Cambridge.

The Thomas Spring & Gear Company, Canisteo, N. Y., will probably build an addition to its plant.

The plant of the Pittsburg (Pa.) Gage & Supply Company was damaged by fire to the extent of $30,000.

The Wolverton Motor Works Company, of Grand Rapids, Mich., is seeking a site in Bridgeport, Conn.

The R. C. Denyes Machine & Tool Company is moving from Hoopeston, Ill., to Gray's Lake, near Chicago.

The American Locomotive Company will, it is said, spend $500,000 in improvements at its plant in Schenectady.

A. C. Booth & Co., St. Paul, Minn., have secured a permit for the erection of a $200,000 cold-storage plant.

The American Iron & Steel Manufacturing Company is erecting a new machine shop at its plant in Lebanon, Pa.

T. W. Castleman, New Orleans, La., is organizing a company to manufacture gasoline engines, automobiles, etc.

The Wire Goods Manufacturing Company, Oklahoma City, Okla., is planning the erection of a factory building.

The Union Bag & Paper Company, of New York, will rebuild its pulp mill, recently burned at Sandy Hill, N. Y.

The Lake Shore Railroad will make big improvements at its shops in Ashtabula, O., a new machine shop being included.

The Florence & Cripple Creek Railroad, whose shops at Canon City, Colo., were recently burned, will rebuild at once.

The Weller Rolling Mills & Forge Company, whose plant at Anniston, Ala., was burned recently, will rebuild in Gadsden, Ala.

The Standard Roller Bearing Company, Philadelphia, Pa., finding it necessary to further enlarge its plant, buys more land.

John Hoban, Dayton, O., formerly with the Buckeye Iron & Brass Works, will establish a foundry for producing unfinished work.

It is said that the Northern Pacific Railroad will erect a new foundry and make other improvements at its shops in Livingston, Mont.

The Midland Linseed Oil Company will build an addition to its plant in Minneapolis, Minn., and install twenty-four more presses.

The Heilers Brothers Company, manufacturing files, rasps, etc., Newark, N. J., is enlarging its plant and will double its output.

The C. O. Jelliff Manufacturing Company, Southport, Conn., manufacturer of wire goods of al kinds, is building an addition to its factory.

W. & T. Avery Company, scale makers, of Birmingham, England, will build a factory at North Milwaukee, Wis., to employ ultimately 500 men.

Payne & Joubert, of New Orleans, manufacturers of Corliss engines and sugar mill machinery, will erect a plant in East Birmingham, Ala.

The Mount Ayr (Iowa) Gas Company, promoted by M. E. Springer, of Des Moines, has been granted a franchise. A $15,000 plant will be erected.

The Hendey Machine Company, Torrington, Conn., has acquired more land, and it is expected that a new foundry will be erected at an early date.

The Delaware, Lackawanna & Western Railroad Company is rebuilding the coach and locomotive shops on a large scale at Kingland, N. J.

The J. L. Mott Company, Trenton, N. J., has practically decided to erect several foundries in the spring, to be used for the casting of iron bath-tubs.

The Baush Machine Tool Company, Springfield, Mass., has started to build an addition to its foundry. A new electric traveling crane will be installed.

E. A. Rusden, Warren, Mass., formerly of the Rusden Machine Company, is said to be at the head of a company to establish a foundry in Warren.

The Butler (Pa.) Car Wheel Company is being formed by T. H. Gillespie, William Bierman and John M. Hanson, of the Standard Steel Car Company.

The Colonna Dry Dock Company has been organized at Norfolk, Va., with a capital of $200,000. A steel shipbuilding and dry-dock plant will be erected.

The Gould Balance Valve Company has been incorporated at Des Moines, Iowa, with a capital of $45,000. W. F. Gould, W. H. Lane, etc., incorporators.

The United States Steel Corporation has practically completed plans for its $20,000,000 plant, which will be erected on Lake Michigan, in the State of Indiana.

One of the manufacturing plants, known as the "Annex plant," of Keuffel & Esser, of New York, which was located in Hoboken, N. J., was destroyed by fire December 8.

The Jackson (Mich.) Fence Company has been formed to manufacture woven wire fencing; capital, $50,000. Incorporators: P. L. Carter, P. H. Withington and others.

The Duluth & Iron Range Railroad Company will expend fully $500,000 in extensions to its machine and repair shops, electric light plant, etc., at Two Harbors, Minn.

Fire at the proving grounds of the War Department at Sandy Hook destroyed the machine, carpenter, blacksmith, paint and plumbing shops, entailing a loss of about $60,000.

The Poughkeepsie Engine Company has been formed to take over the business of the Birdsall Manufacturing Company, of Auburn, N. Y., and will establish a plant in Poughkeepsie, N. Y.

Dr. A. M. Cole, Akron, O.; E. A. Henry, Cuyahoga Falls, and others have organized the Seneca Wire & Manufacturing Company, with a capital of $100,000. A plant will be erected in Fostoria, O.

The Salem Iron Works, Winston-Salem, N. C., is in the market for a short bed lathe or boring mill (second hand) which will handle pulleys 10 feet diameter. Mention freight rate to Winston-Salem.

Capt. W. T. Burwell, commanding the Bremerton (Wash.) Navy Yard, has received authority to advertise for bids on the construction of boiler and blacksmith shops at an estimated cost of $100,000.

Plans are being completed for the construction of five new furnaces at the plant of the Bethlehem Steel Company, South Bethlehem, Pa. A rolling mill for the manufacture of structural steel is also to be installed.

A new compressed-air house-cleaning machine factory is being erected at Wauseon, O. E. L. Barber, president of the Bank of Wauseon, is a stockholder in the company. A foundry will be run in connection with the plant.

The New England Boiler Company, to manufacture house steam-heating boilers, has been incorporated with a capital of $200,000. Frank R. Hazard, Mystic, Conn., is president, and a foundry and machine shop will be erected in that place.

The Toledo (O.) Shipbuilding Company, with a capital of $1,100,000, has been incorporated and has purchased the plant of the Craig Shipbuilding Company. The new company will build its own foundries, machine shops and wood-working mills.

The New Jersey Combustion Company, capitalized at $10,000, has been incorporated at Elizabeth, N. J., for the purpose of manufacturing furnaces, boilers, etc. The plant will be located in Elizabethport. James L. Stewart and others, incorporators.

The Buckeye Gas Engine Company has been organized at Delta, O. The company has purchased the business of the Underwood Manufacturing Company at Elmore, and will move the plant to Delta, where it will erect a large factory. A complete foundry will be added in the spring.

The Fort Pitt Steel Company, which recently applied for a charter, has leased a plot of ground in McKeesport, Pa., where a plant employing from 100 to 200 men will be erected. C. S. Koch, formerly with the American Steel Foundries, of Pittsburg, is one of the incorporators.

The steam railroad running from MacKay's Ferry to Beaufort, N. C., will be built for the Virginia & Carolina Coast Railway Company. This road will extend a total length of approximately 120 miles. The contract has been awarded to J. G. White & Co., 43 Exchange Place, New York, who will do all the clearing, grading and track-laying work as well as the building of steel bridges and viaducts.

Plans are being prepared by the Hydraulic Machine Company, of Pittsburg, Pa., for an enlargement of its plant in Lawrenceville, which will be followed by a change in the method of operating considerably. The company has manufactured steel castings, and has an iron and brass foundry. The plan is to separate the steel casting business from the rest and operate under a separate company, to be chartered and known as the Iron City Steel Castings Company.

The Oswego Boiler Works, at Oswego, N. Y., has been purchased by New York parties understood to be associated with the A. D. Granger Company, the machinery house at 95 Liberty street, New York, with branches at Philadelphia and Pittsburg. The plant, which occupies about twenty acres on the lake front, was established some twelve years ago, and it is expected will be placed in active operation at once. Steel plate work in all branches, including boilers, tanks and stacks, will be manufactured. The new company will be known as the Oswego Boiler & Engine Company, with the main office at Oswego, N. Y.

New Catalogues.

Geo. R. Rich Manufacturing Company, Buchanan, Mich. Bulletin describing drills and chucks. Illustrated. 5x7, paper.

Gardner Machine Company, Beloit, Wis. Catalogue of "Gardner's Improved" disk grinders. Illustrated. 6x9, pp. 8, paper.

Ingersoll-Rand Company, 11 Broadway, New York. Leaflet, Form 355, on compressed-air displacement pumps. Illustrated. 3½x6, paper.

Standard Welding Company, Cleveland, O. Booklet illustrating seamless steel rings made by the electric welding process. 3½x6, pp. 7, paper.

Frederick Goetze, 723 East 141st street, New York. Circular containing description and price list of patent copper gaskets. Illustrated.

B. F. Sturtevant Company, Hyde Park, Mass. Pamphlet describing the Sturtevant vertical engine, Class VS5. Illustrated. 6½x9, pp. 8, paper.

C. W. Hunt Company, West New Brighton, N. Y. Catalogue No. 0510, describing the "Hunt" automatic railway. Illustrated. 6½x9, pp. 36, paper.

G. W. Price Pump Company, 523 Market street, San Francisco, Cal. Catalogue (C. P. No. 3) of centrifugal pumps. Illustrated. 6x9, pp. 44, paper.

Newton Machine Tool Works, Inc., Philadelphia, Pa. Catalogue No. 42, describing horizontal slab milling machines. Illustrated. 6x9, pp. 23, paper.

Buffalo Forge Company, Buffalo, N. Y. Leaflet showing Buffalo centrifugal pumps and blowers direct connected to Cooley rotary engines. 5½x7, pp. 4.

Northern Electrical Manufacturing Company, Madison, Wis. Leaflet No. 148, showing some applications of Northern motor drive in hoisting work. 3½x6½, pp. 4.

Pressed Steel Pole Company, Pittsburg, Pa. Catalogue describing pressed-steel poles for telegraph, telephone, trolley, electric-light service, etc. Illustrated. 6x9, pp. 18, paper.

W. H. Nicholson & Co., Wilkesbarre, Pa. Catalogue, "The End of Your Mandrel Troubles Is in Sight," which describes the Nicholson expanding mandrels. Illustrated. 6x9, pp. 24, paper.

Wyman & Gordon, Worcester, Mass. "A Short Story of Geo. H. Corliss—Part I." This contains a picture of the inventor of the Corliss engine, and no doubt will be of interest to all mechanics.

Bullard Automatic Wrench Company, 257 West Exchange street, Providence, R. I. Catalogue describing automatic wrench. This is an attractive little book, containing very fine half-tone engravings. 5x8, paper.

Westinghouse Companies' Publishing Department, Pittsburg, Pa. Advance copy of a small folder illustrating storage batteries for railway signal service, made by the Westinghouse Machine Company. 4x5½, pp. 15.

American Steam Gauge & Valve Manufacturing Company, 208-220 Camden street, Boston, Mass. Circular illustrating and describing the American-Thompson improved indicator with new improved detent motion.

F. E. Myers & Bro., Ashland, O. Catalogue and price list of horizontal and vertical power pumps, working heads, pumping jacks, countershafts, boiler feeder pumps, irrigation cylinders, etc. Illustrated. 6x9, pp. 47, paper.

Electro-Dynamic Company, Bayonne, N. J.; 11 Pine street, New York. Circular No. 18, showing some of the more recent applications of the Inter-Pole motor to various classes of machinery. Illustrated. 6x9, pp. 4, paper.

The Zephyr Ventilator Manufacturing Company, Philadelphia, Pa. Catalogue describing the Philadelphia radial lamp-holder, which can be attached to lathes, planers, drills, drawing-boards, desks, etc. Illustrated. 3½x6, paper.

Otis Elevator Company, New York. Catalogue describing, in general, elevating machinery and apparatus manufactured by this company. This is well printed and contains a number of half-tone illustrations. 8x9, pp. 62, paper.

Francis H. Richards Engineering and Patent Offices, 9-15 Murray street, New York. Catalogue containing information respecting the patent laws and requirements of the principal foreign patent-granting countries. 4x7, pp. 50, paper.

Niles-Bement-Pond Company, 111 Broadway, New York. November issue of the "Progress Reporter," which contains illustrations of some new tools, including a new radial drill, 42-inch boring and turning mill, electric hoists, etc.

B. F. Sturtevant Company, Hyde Park, Mass. Bulletin No. 75, entitled "Mechanical Draft: What It Is, What It Does." This contains interesting data on the subject, with illustrations and descriptions of installations. 3½x6½, pp. 11, paper.

Fitchburg Machine Works, Fitchburg, Mass. Catalogue of the Lo-swing lathe. This is a very handsome book, printed on antique wove paper and containing very complete description of the lathe as well as excellent half-tone illustrations. 6x9, pp. 27, cloth.

The R. K. Le Blond Machine Tool Company, Cincinnati, O. Booklet entitled "The Modern Milling Machine," giving the distinctive features of the milling machine made by this company; specifications, line drawings and half-tone engravings. 4x6, pp. 64, paper.

W. F. & John Barnes Company, Rockford, Ill. Catalogue No. 64 of upright drills and other machine tools, including water emery grinder, adjustable screw press, etc. This is printed on fine coated paper, and is well illustrated by half-tone engravings. 6x9, pp. 54, paper.

National Electric Company, Milwaukee, Wis. Bulletin No. 359, illustrating and describing polyphase induction motors. 7x10, pp. 8. Bulletin No. 363, illustrating and describing stationary and portable motor-driven air compressors for continuous and intermittent service. 7x10, pp. 8.

Olds Gasoline Engine Works, Lansing, Mich. Bulletin No. 1, describing and illustrating type "A" gasoline engines for small power. 8x10½, pp. 12. All future advertising matter of this concern will be handled through bulletins, which will be sent on request to those interested.

The Goldy Machine Company, Sunnyvale, Cal. Pamphlet containing illustrations of the various stages of construction of the plant of this company, now nearing completion, and giving its purposes, which will be the making of all kinds of steel castings and other castings, medium-heavy and light machinery, etc. 5½x8, paper.

The Watson-Stillman Company, 46 Dey street, New York. Sectional Catalogue No. 67, entitled "Hydraulic Accumulators and Fittings." This contains descriptions of various types of accumulators, including the hydropneumatic accumulator, and a few valves especially used with the accumulators. Illustrated. 6x9, pp. 54, paper.

Fort Wayne Electric Works, Fort Wayne, Ind. Bulletin No. 1071, illustrating and describing small power motors. Bulletin No. 1072, on type "S" single-phase motors. Bulletin No. 1074, illustrating and describing multiphase induction integrating type "K" wattmeters. Instruction book No. 3022 on type "M" multiphase induction motors.

C. W. Hunt Company, West New Brighton, S. I., N. Y. Catalogue No. 058, entitled "'Hunt' Steam Hoisting Engines," which describes engines especially designed for heavy duty, giving tables, illustrations of the different parts of the engines, as well as of standard engines and special engines. There are also illustrations showing some installations. 7x9, pp. 32, paper.

The Emerson Electric Manufacturing Company, St. Louis, Mo. Bulletin No. 3107 (replacing No. 3062), illustrating and describing single-phase induction motors, Class 24 FA, full load automatic start; Class 24 DA, light load automatic start. 7x10, pp. 8. Bulletin No. 3953, illustrating and describing electric bottle washers for cleaning bottles and arc lamp globes. 7x10, pp. 4.

Electro-Dynamic Company, Bayonne, N. J. Circular No. 16, Series "B," describing interpole variable-speed motor. This is illustrated and contains a number of line-cuts giving dimension elevations. 6x9, pp. 12, paper. Circular No. 17, entitled "Individual Motor-Driven Machines," which shows the application of the inter-pole variable-speed motor to different machine tools. Illustrated. 6x9, pp. 8, paper.

Buffalo Steam Pump Company, Buffalo, N. Y. Catalogue No. 87. This is in two sections—section No. 1 describing steam and power pumps of all types and giving complete price lists; section No. 2 is devoted to centrifugal and turbine pumps, and contains tests, states the characteristics of centrifugal pumps, where they should be used, etc. It also gives details of construction, and is full of useful information. 6x7½, pp. 130, paper.

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers, 75 Broad st., New York.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACH.

Electrical apparatus designed and built. Geo. M. Mayer, 1131 Monadnock Block, Chicago, Ill.

We make working drawings for others; why not for you? 627 Rose Bldg., Cleveland, O.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Wanted—Patented specialties of merit to manufacture and market. Power Specialty Co., 500 Washington ave., Detroit, Mich.

Make us your factory.

Specialties and machinery built to order. Close work; close prices. "Moderate," AM. M.

Work wanted for a Cleveland automatic lathe; handles 2 in. and under. The Earle Gear & Machine Co., 141 Oxford st., Philadelphia.

Clock work and intricate mechanical instruments; meter counters, water, gas or electric; recording devices; special movements to order. D. S. Plumb, 57 E. Park st., Newark, N. J.

Wanted—One Brown & Sharpe second-hand automatic screw machine, No. 0; also one No. 2. Address, giving time they have been in use and character of work they have been making, also price, George W. Dover Company, Providence, R. I.

Wanted—36 in. x 36 in. x 20 ft. two-head planer, No. 3 plain Cincinnati milling machine, one 4-spindle drill press for ⅝ in. holes in center distance of a 3 in. square. These tools may be second-hand, but must be in first-class condition. Address Box 916, AMERICAN MACHINIST.

Tool Catalogue No. 22. 950 pages, bound in cloth. Greatest small-tool catalogue ever published. Will be sent post-paid on receipt of $1. Money paid for catalogue refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton st., New York City.

New York City, Dec. 15, 1905.

The annual meeting of the stockholders of The Derry-Collard Co. for the election of officers, and for the transaction of such other business as may properly come before the meeting, will be held at the offices of the company, 256-257 Broadway, Manhattan, on Jan. 8, 1906, at 6 o'clock in the afternoon.

A. LEIGHTON DONNELL, Treas.

For Sale.

For Sale—10-ton crane, 40 ft. span, rope drive; has been tested to 20 tons; very low price for cash. Address Murray Iron Works Co., Burlington, Iowa.

For Sale—One Fellows gear shaper; a 36 in. machine, which has been in use only a year; three sets of arbors included. Address Box 900, AMERICAN MACHINIST.

For Sale—A bargain; 96 in. gap second-hand steam riveter, 36 in. cylinder; good as new; Wm. Sellers & Co. make; price $500. Box 923, AMERICAN MACHINIST.

For Sale—1,200-light electric plant, consisting of 100 H.-P. Payne engine and 60-kilowatt Edison dynamo; perfect condition; low price to quick purchaser. Apply to Estate of Henry C. Miner, 194 Bowery, New York.

For Sale—A small machine shop outfit, including patterns for special machines for domestic and export trade, and doing a jobbing business also. Reasons for selling, ill health and age of owner. Address Box 913, AM. M.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted.

Classification indicates present address of advertiser, nothing else.

ILLINOIS.

Experienced, up-to-date and successful superintendent wishes to make a change Jan. 1; record of 5 years' successful work in present position; thoroughly experienced in modern shop methods, and can reduce costs and systematize factory; Chicago or Middle West preferred. Box 911, AMERICAN MACHINIST.

INDIANA.

Superintendent; age 35; practical machinist; natural ability and wide experience handling men and reducing costs. Box 713, A. M.

MASSACHUSETTS.

American, 39, college education, practical shop and drafting-room experience, has had

complete charge of organizing and running machine shop, also charge of business management, and has sold machinery in foreign countries, desires position with manufacturing company or machine-tool firm; best of references given. Box 912, AMER. MACHINIST.

NEW JERSEY.

Position wanted by experienced mechanical draftsman. Box 909, AMER. MACHINIST.

As engineer or assistant, by technical graduate, 34; good shop man and designer; young firm with prospects preferred. Box 904, A. M.

Superintendent or general foreman; 18 years' experience as such; practical mechanic; up to date; interchangeable work preferred; a hustler; good reasons for seeking change; best references. Box 924, AMER. MACHINIST.

NEW YORK.

A young tool and die maker, with 15 years' experience on small and medium work, would like a change by Jan. 1; have also had charge of milling department. Box 910, AM. MACH.

General foreman, responsible man, 36, experienced in high-grade duplicate general and mill machinery, expert machinist, wishes to make change. Pacific States preferred. Box 883, AMERICAN MACHINIST.

Mechanical draftsman; thoroughly experienced on machine, structural, steam engine and general repair work, with 2 years' experience in machine shop and 5 in drafting room; can take charge of construction work; also 2 years' experience in electrical work; at present employed with company building machine tools; would like position in Greater New York or Jersey City. Please do not answer unless you mean business. P. O. Box 339, Yonkers, N. Y.

Help Wanted.

Classification indicates present address of advertiser, nothing else.

CONNECTICUT.

Wanted—Two floor and two planer hands on heavy work; steady work and good wages; no trouble; only first-class men wanted; state wages and experience. Farrel Foundry & Machine Co., Ansonia, Conn.

Wanted—A first-class engineer for stationary engine; one capable of handling engine and directing fireman; we operate about 400 H.-P. and use generator and electric current for about 125 H.-P.; want a thoroughly competent man. Address Box 922, AMER. MACH.

ILLINOIS.

Draftsmen.—We have positions now open for draftsmen. Call or address Western Electric Co., Chicago, Ill.

Salesman with mechanical education and experience in selling gasolene engine machinery especially; advise fully relative to experience, age, references and salary expected. Box 918, AMERICAN MACHINIST.

MASSACHUSETTS.

Wanted—Fellows gear shaper operators, also turret lathe men. Boston Gear Works, Boston, Mass.

Wanted—Several competent mechanical draftsmen with experience in designing hydraulic machinery; state age and give references. Box 898, AMERICAN MACHINIST.

Several competent machinists wanted, with experience in structural iron work; state age and experience; only those capable of laying out work need apply. Address Box 907, A. M.

Master mechanic, experienced and capable of supervising 1,000 H.-P. electric power and lighting plant, including repairs on same, millwrighting, plumbing, etc., in factory near Boston. Box 915, AMERICAN MACHINIST.

Machinists Wanted—We are increasing our force and need good, all-round men for the building of special automatic machinery and jobbing. References as to character and ability required. Apply to L. F. Fales, Walpole, Mass.

MICHIGAN.

Wanted—3 or 4 first-class, A1 automatic screw machine hands; to experienced men will guarantee steady position and highest rate of wages. Answer, with reference, to Box 85, Detroit, Mich.

Wanted—Experienced machine operator for a new No. 1 Lucas horizontal boring, drilling and milling machine, in Detroit; state experience and wages. Address Box 892, AMERICAN MACHINIST.

MINNESOTA.

Wanted—Die and tool makers and bench hands, accustomed to small, accurate work; must be first class in every respect; highest wages. G. F. Kriesel 2d st. and 5th ave., south, Minneapolis, Minn.

NEW JERSEY.

Wanted—A first-class mechanical draftsman; state experience and salary wanted. Box 881, AMERICAN MACHINIST.

Wanted—A first-class foundry foreman who can make good machinery castings at a reasonable cost; state references and salary expected. Box 891, AMERICAN MACHINIST.

We are increasing our works and want applications for machinist foremen and machinists; in reply give details of experience, age and wages expected. The Edison Portland Cement Co., Stewartsville, N. J.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

Lathe, planer and boring mill operators wanted for night shift; those accustomed to machine tool work preferred; steady work and good pay to good men. Address the Pond Machine Tool Co., Plainfield, N. J.

Wanted—Foreman; experienced man, to take charge of brass shop, manufacturing fittings, valves and plumbing specialties; give full particulars as to age, experience and salary last received. Box 897, AMER. MACH.

NEW YORK.

Draftsmen for jigs, fixtures, dies and shop tools. Apply to Mergenthaler Linotype Co., Brooklyn, N. Y.

First-class machinists for bench and tool work; those familiar with gas engines preferred. Box 917, AMERICAN MACHINIST.

Wanted—Several first-class toolmakers on dies, jigs and special fixtures for small machine manufacture. Send references to Drawer No. 7, Syracuse, N. Y.

Wanted—Machinery designer and draftsman; bright and active man with practical ideas; state experience, etc. Niagara Machine & Tool Works, Buffalo, N. Y.

Young man, to set multiple plunger presses in New York city factory, as assistant to foreman; state age, experience and wages expected. Box 920, AMERICAN MACHINIST.

Wanted—For general office work, young man acquainted with shafting and pulley trade; state experience, age, salary expected and references. Address Box 925, AM. M.

Wanted—An experienced salesman to sell milling cutters, twist drills and similar small tools; state experience, salary wanted. Address "H. S.," P. O. Box 1347, New York.

Machinists for floor work; must be first-class men who will appreciate steady employment; open shop; 9 hours per day; wages $2.50. Address Box 859, AMER. MACHINIST.

Wanted—Experienced draftsmen, first-class machinists, toolmakers, and gauge makers; give detailed experience, references, age and wages expected. Remington Arms Company, Ilion, N. Y.

We require the services of 20 draftsmen and 10 tracers at once; permanent positions with a well-established concern in N. Y. city; work consists of furnishing detailed manufacturing information for a large shop; previous experience in our line not essential; state age, nationality, experience and salary expected. Address Box 893, AMER. MACH.

OHIO.

Draftsman, familiar with motors; also metal pattern maker; state experience and wages. Address Box 914, AMER. MACHINIST.

Wanted—Mechanical designer and draftsman who is capable of superintending a small shop building butchers' and bakers' machinery; must speak German and English; a very good opportunity. Address "N. E. M.," care AMERICAN MACHINIST.

Wanted—First-class foundry foreman, with executive ability, to take charge of foundry employing 200 hands; medium and light, floor, bench and machine molding; good salary to competent man. Address, with reference, Box 872, AMERICAN MACHINIST.

PENNSYLVANIA.

Draftsman wanted at $2 to $3.50 per day; location, eastern Pennsylvania. Reply to "Machine Tools," care AMERICAN MACHINIST.

Wanted—A number of mechanical draftsmen; those with experience in electrical apparatus, generators or motors preferred; only first-class men need apply. Addess Chief Draftsman, Westinghouse Electric & Manufacturing Co., Pittsburg, Pa., P. O. Box 911.

WISCONSIN.

To meet our constantly increasing requirements, we invite applications from first-class machinists and bench hands; those familiar with engine work preferred. Box 921, AM. M.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen, with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMER. MACHINIST.

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Safety Emery Wheel Co., Springfield, O.
Vitrified Wheel Co., Westfield, Mass.

Aftercoolers, Air

Ingersoll-Rand Co., New York.

Air Lifts

Ingersoll-Rand Co., New York.

Arbors

Morse Twist Drill & Mach. Co., New Bedford, Mass.

Arbor Presses

Barnes Co., W. F. & John, Rockford, Ill.
Bartlett, E. E., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Wilmarth & Morman Co., Grand Rapids, Mich.

Architects

Dodge & Day, Philadelphia, Pa.

Auctioneers

Shaw & Co., New York.

Ball Bearings

See Roller Bearings.

Barrels, Steel

Kilbourne & Jacobs Mfg. Co., Columbus, O.

Bars, Boring

Beaman & Smith Co., Prov., R. I.
Cleveland Twist Drill Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.,
Three Rivers Tool Co., Three Rivers, Mich.
Underwood & Co., H. B., Philadelphia, Pa.,

Bars, Boring Cylinder

Underwood & Co., H. B., Philadelphia, Pa.,

Belt Connectors

Ellis Co., H. G., Clearfield, Pa.

Belt Dressing

Dixon Crucible Co. Jos., Jersey City, N. J.
Shultz Belting Co., St. Louis, Mo.

Belt Filler

Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.

Belt Lacing Machine

Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.

Belting, Leather

Schieren & Co., Chas. A., New York.
Shultz Belting Co., St. Louis, Mo.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Bending Machinery, Plate

Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toledo Machine Tool Co., Toledo, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Bending Machines, Hydraulic

Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Bending Machines, Power

Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Boynton & Plummer, Worcester, Mass.

Bending Machines, Power *Continued*

Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Bending Tools, Hand

Wallace Supply Co., Chicago, Ill.

Bicycle Parts

Standard Welding Co., Cleveland, Ohio.

Blanks, Nuts and Screws

Whitman & Barnes Mfg. Co., Chicago, Ill.

Blocks, Chain

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Blowers

Am. Gas Furnace Co., N. Y. City.
Buffalo Forge Co., Buffalo, N. Y.
Chicago Flexible Shaft Co., Chicago, Ill.
General Electric Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Sturtevant Co., B. F., Hyde Park, Mass.

Blue Print Machines

General Electric Co., New York.

Boilers

Struthers-Wells Co., Warren, Pa.

Bolt and Nut Machinery
Acme Machy. Co., Cleveland, O.
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Brown Co., H. B., Easthampton, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
Harrington & Son Co., Edwin, Philadelphia, Pa.
Landis Mach. Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Reliance Mach. & Tool Co., Cleveland, O.
Standard Engineering Works, Ellwood City, Pa.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Bolts, Coupling
Cleveland Cap Screw Co, Cleveland, O.
National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts
Cleveland Cap Screw Co., Cleveland, O.
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Books, Mechanical
American School of Correspondence, Chicago, Ill.
Audel & Co., Theo., New York.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Modern Machy. Publishing Co., Chicago, Ill.
Wiley & Sons, Jno., New York.

Boosters
C & C Elec. Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
General Elec. Co., New York.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Boring and Drilling Machines, Horizontal
Barnes Co., B. F., Rockford, Ill.
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Beaman & Smith Co., Prov., R. I.
Betts Mach. Co., Wilmington, Del.
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Dallett Co., Thos. H., Phila., Pa.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Fosdick Mach. Tool Co., Cin., O.
Gisholt Mach. Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Lucas Mach. Tool Co., Cleve., O.
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Springfield Mch. Tool Co., Springfield, O.
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Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Boring and Turning Mills
American Tool Wks. Co., Cin., O.
Baker Bros., Toledo, O.
Baush Mach. Tool Co., Springfield, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
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Ridgway Mach. & Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.

Boring Tools
Armstrong Bros. Tool Co., Chicago, Ill.
Bown Mach. Co., Battle Creek, Mich.

Brackets, Lamp
Standard Welding Co., Cleve., O.

Bulldozers
Prentiss Tool & Supply Co., New York.
Toledo Machine Tool Co., Toledo, Ohio.
Williams, White & Co., Moline, Ill.

Cabinets, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Walker Co., O. S., Worcester, Mass.

Calipers
Athol Mach. Co., Athol, Mass.
Starrett Co., L. S., Athol, Mass.

Cams
Boston Gear Works, Boston, Mass.

Carborundum
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Castings, Brass and Bronze
Messmer Mfg. Co., Ferd., St. Louis, Mo.

Castings, Die Molded
Franklin Mfg. Co., Syracuse, N. Y.

Castings, Iron
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Massey Mach. Co., Watertown, N. Y.
Poole Co., J. Morton, Wilmington, Del.
United Engrg. & Fdry Co. Pittsburg Pa.
U. S. Foundry & Sales Co., South Norwalk, Conn.
Yale & Towne Mfg. Co., Stamford, Conn.

Castings, Steel
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Kent & Co., Edwin R., Chicago, Ill.

Cement, Cast Steel
Clark Cast Steel Cement Co., Shelton, Conn.

Centering Machines
Hendey Mach. Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Phoenix Mfg. Co., Hartford, Ct.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

Centers, Planer
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Woodward & Powell Planer Co., Worcester, Mass.

Chains, Driving
Baldwin Chain & Mfg. Co., Worcester, Mass.
Boston Gear Works, Boston, Mass
Cullman Wheel Co., Chicago, Ill.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., The, Columbus, Ohio.
Link Belt Engr. Co., Phila., Pa.
Morse Chain Co., Trumansburg, N. Y.
Whitney Mfg. Co., Hartford, Ct.

Chisels, Cold
Anderson & Sons Co., Detroit, Mich.
Hammacher, Schlemmer & Co., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Chucking Machines
American Tool Works Co., Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Automatic Mach. Co., Cleveland, O.
Gisholt Mach. Co., Madison, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Chucks, Drill
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co, Cleveland, O.
Cushman Chuck Co., Hartford, Ct.
Goodell-Pratt Co., Greenfield, Mass.
Horton & Son Co., The E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Morse Twist Drill & Mach. Co., New Redford, Mass.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe
Cushman Chuck Co., Hartford, Ct.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., The E., Windsor Locks, Conn.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Magnetic
Walker Co., O. S., Worcester, Mass.

Chucks, Planer
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Walker Co., O. S., Worcester, Mass.

Chucks, Split
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Switchboard Equipment Co., Bethlehem, Pa.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Clamps
Billings & Spencer Co., Hartford, Conn.

Clutches, Friction
American Tool & Mach. Co., Boston, Mass.
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Mchy. Co., New Haven, Conn.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Engineering Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Wood's Sons, T. B., Chambersburg, Pa.

Clutches, Magnetic and Electrical
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Coal Handling Machinery
Link-Belt Engineering Co., Philadelphia, Pa.

Coils
Standard Welding Co., Cleve., O.

Compound, Pipe Joint
Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air
Blaisdell Mchy. Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Christensen, N. A., Milwaukee, Wis.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Mietz, August, New York.

Compressors, Gas
Ingersoll-Rand Co., New York.

Condensers
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.

Conduit, Interior
Sprague Elec. Co., New York.

Cones, Friction
Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps
Erie Forge Co., Erie, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work
Blanchard Mach. Co., Boston, Mass.

Controllers and Starters, Electric Motor
Crocker-Wheeler Co., Ampere, N. J.
Cutler-Hammer Clutch Co., Milwaukee, Wis.
General Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Coping Machines
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Correspondence Schools
See Schools, Correspondence.

Cotters
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Provi., R. I.

Counters, Machinery
Durbrow & Hearne Mfg. Co., New York.
Veeder Mfg. Co., Hartford, Conn.

Countershafts
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

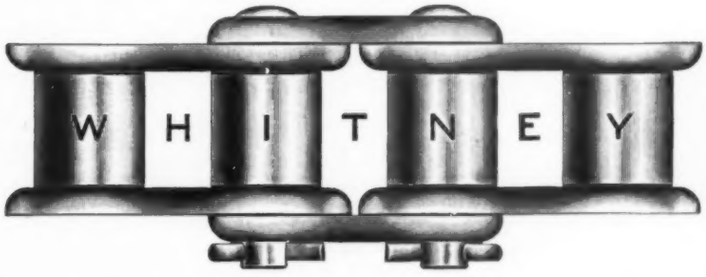
Countershafts, Speed Changing
Cresson Co., Geo. V., Phila., Pa.
Gisholt Mach. Co., Madison, Wis.
Reeves Pulley Co., Columbus, Ind.
Speed Changing Pulley Co., Indianapolis, Ind.

Counting and Printing Wheels
Franklin Mfg. Co., Syracuse, N. Y.

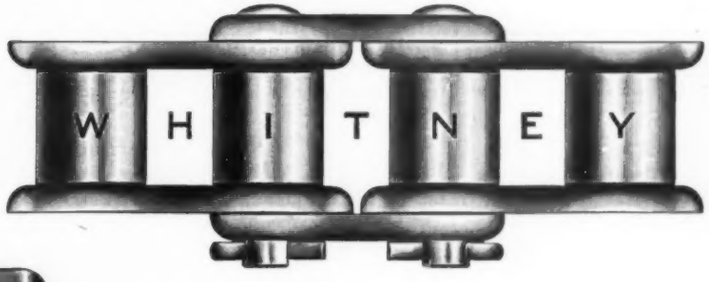
Couplings, Hose
Ingersoll-Rand Co., New York.

Couplings, Shaft
Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.

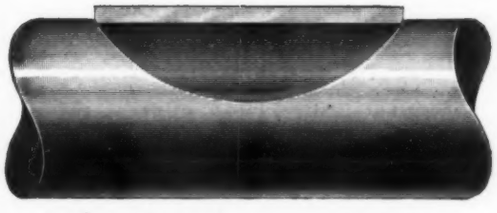
"WIZARD" Chains and Sprockets—Patented



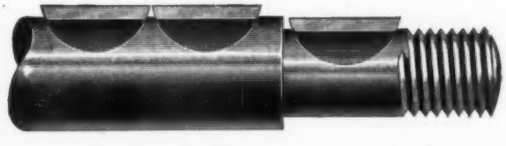
1906 Model "Whitney" Detachable Roller Chains—Patented



Block Chains



"Woodruff" Patent Keys



Three Popular Specialties

"Whitney" Chains
Hand (feed) Milling Machines
The Woodruff Patent System of Keying

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Vandyck Churchill Co., New York.

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Morse Twist Drill & Mach. Co., New Bedford, Mass.
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Hurlbut-Rogers Mach. Co., South Sudbury, Mass.
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Nutter, Barnes & Co., Boston, Mass.
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Vandyck Churchill Co., New York.

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Pratt & Whitney Co., Hartford, Conn.

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Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Dickinson, Thos. L., New York.
Francis Co., Hartford, Conn.

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Kent & Co., Edwin R., Chicago, Ill.
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Risdon, S. A., Waterbury, Conn.
Waltham Machine Works, Waltham, Mass.

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Pratt & Whitney Co., Hartford, Conn.
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Ingersoll-Rand Co., New York.

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Barnes Co., W. F. & John, Rockford, Ill.
Boynton & Plummer, Worcester, Mass.
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Goodell-Pratt Co., Greenfield, Mass.
Ingersoll-Rand Co., New York.
McGeorge & Sons, Cleveland, O.
Patterson Tool & Supply Co., Dayton, O.
Pratt & Whitney Co., Hartford, Conn.

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Bickford Drill & Tool Co., Cincinnati, O.
Boynton & Plummer, Worcester, Mass.
Dallett Co., Thos. H., Phila., Pa.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

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Barnes Co., W. F. & John, Rockford, Ill.
Baush Mach. Tool Co., Springfield, Mass.
Bickford Drill & Tool Co., Cincinnati, O.
Dallett Co., Thos. H., Phila., Pa.
Dwight Slate Mach. Co., Hartford, Conn.
Fenn-Sadler Mach. Co., Hartford, Conn.
Foote, Burt & Co., Cleveland, O.
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Garvin Mach. Co., New York.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
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Dallett Co., Thos. H., Phila., Pa.
Hisey-Wolf Mach. Co., Cincin., O.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.

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Dreses Mach. Tool Co., Cin., O.
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Foote, Burt & Co., Cleveland, O.
Fosdick Mach. Tool Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hill, Clarke & Co., Boston, Mass.
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Mueller Mach. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York
Ridgway Mach. Tool Co., Ridgway, Pa.
Vandyck Churchill Co., New York.

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Niles-Bement-Pond Co., New York.

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Barnes Co., W. F. & John, Rockford, Ill.
Beaman & Smith Co., Prov., R. I.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Boynton & Plummer, Worcester, Mass.
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Dallett Co., Thos. H., Phila., Pa.
Dwight Slate Mach. Co., Hartford, Conn.
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Fenn-Sadler Mach. Co., Hartford, Conn.
Fosdick Mach. Tool Co., Cincinnati, O.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Henry & Wright Mfg. Co., Hartford, Conn.
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Whitney Mfg. Co., Hartford Conn.
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Standard Tool Co., Cleveland, O.

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Dallett Co., Thos. H., Phila., Pa.
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Standard Tool Co., Cleveland, O.

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Armstrong Bros. Tool Co., Chicago, Ill.
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Curtis & Curtis Co., Bridgeport, Conn.
Hisey-Wolf Mach. Co., Cincin., O.
Parker Co., Chas., Meriden, Conn.
Pratt & Whitney Co., Hartford, Conn.
Rogers, Boat, Gauge & Drill Wks., John M., Gloucester City, Mass.
Standard Tool Co., Cleveland, O.

Drills, Rock
Ingersoll-Rand Co., New York.
Northern Elec. Mfg. Co, Madison, Wis.

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Three Rivers Tool Co., Three Rivers, Mich.

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Jantz & Leist Elec. Co., Cin., O.
Northern Elec. Mfg. Co., Madison, Wis.
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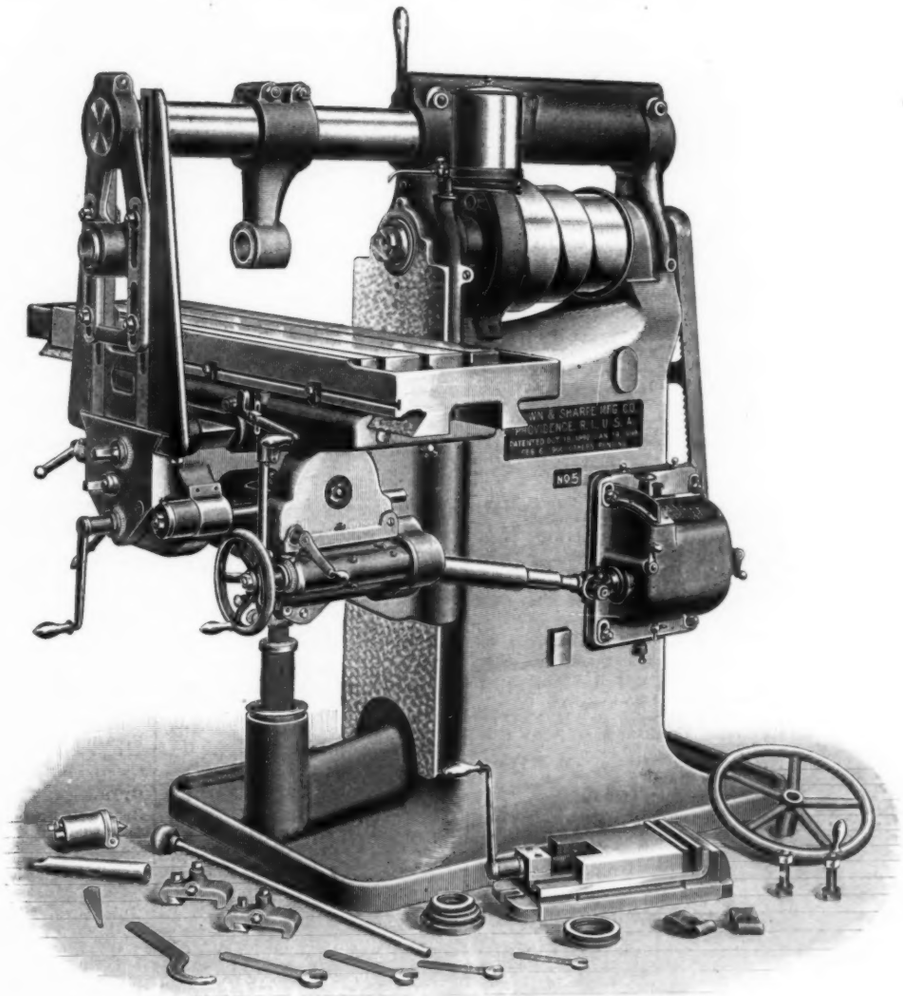
Distinctive Features That Recommend Them



Variable Feeding Mechanism driven direct from spindle to gear case. No intermediate gearing. Full efficiency available for the drive.

Feed can be reversed at any point of table travel.

All hand wheels and levers for controlling the feeds arranged to enable the operator to have full control without changing his position.

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Sturtevant Co., B. F., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

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Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
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Buffalo Forge Co., Buffalo, N. Y.
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Wyman & Gordon, Worcester, Mass.

Forgings, Hydraulic
Wyman & Gordon, Worcester, Mass.

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Chicago Flexible Shaft Co., Chicago, Ill.

Furnaces, Enameling
American Gas Furnace Co., New York.

Furnaces, Gas
Am. Gas Furnace Co., N. Y. City.
Chicago Flexible Shaft Co., Chicago, Ill.
Westmacott Co., J. M., Providence, R. I.

Furnaces, Melting
American Gas Furnace Co., New York.

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New Britain Mach. Co., New Britain, Conn.

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Pratt & Whitney Co., Hartford, Conn.
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Slocomb Co., J. T., Prov., R. I.
Starrett Co., L. S., Athol, Mass.

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Dwight Slate Mach. Co., Hartford, Conn.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Morse, Williams & Co., Phila., Pa.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
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Whiton Machine Co., D. E., New London, Conn.

Gear Testing Machinery
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Gears, Cut
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Wks., Boston, Mass.
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Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
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Earle Gear & Mach. Co., Philadelphia, Pa.
Eberhardt Bros. Mach. Co., Newark, N. J.
Fawcus Mch. Co., Pittsburg, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Ganschow, Wm., Chicago, Ill.
Gould & Eberhardt, Newark, N. J.
Gleason Works, Rochester, N. Y.
Grant Gear Works, Boston, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., The, Cleveland, O.
Massey Mach. Co., Watertown, N. Y.
Messmer Mfg. Co., Ferd., St. Louis, Mo.
Morse, Williams & Co., Phila., Pa.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Patterson, Gottfried & Hunter, Ltd., New York.
Philadelphia Gear Works, Philadelphia, Pa.
Sawyer Gear Wks., Cleveland, O.
Simonds Mfg. Co., Pittsburg, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Molded
Caldwell & Son Co., H. W., Chicago, Ill.
Farrel Fdry. & Mach. Co., Ansonia, Conn.
Franklin Mfg. Co., Syracuse, N. Y.
Greenwald Co., I. & E., Cin., O.
Philadelphia Gear Wks., Philadelphia, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

Gears, Rawhide
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Chicago Raw Hide Mfg. Co., Chicago, Ill.
Fawcus Mch. Co., Pittsburg, Pa..
Gould & Eberhardt, Newark, N. J.
Horsburgh & Scott Co., Cleveland, Ohio.
New Process Raw Hide Co., Syracuse, N. Y.
Nuttall Co., R. D., Pittsburg, Pa.
Philadelphia Gear Works, Philadelphia, Pa.
Syracuse Raw Hide Co., Syracuse, N. Y.

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Bair & Gazzam Mfg. Co., Pittsburg, Pa.
Boston Gear Wks., Boston, Mass.
Fawcus Mch. Co., Pittsburg, Pa.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Morse, Williams & Co., Phila., Pa.
Nuttall Co., R. D., Pittsburg, Pa.

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Simonds Mfg. Co., Pittsburg, Pa.
Taylor-Wilson Mfg. Co., Allegheny, Pa.

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Sprague Elec. Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Boston, Mass.
Triumph Elec. Co., Cincinnati, O.

Generators, Gas
American Gas Furnace Co., New York.

Gibs
Standard Gauge Steel Co., Beaver Falls, Pa.

Graphite
Dixon Crucible Co., Jos., Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Grinders, Automatic Knife
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.

Grinders, Center
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Heald Mch. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Mueller Mch. Tool Co., Cin., O.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Rivett-Dock Co., Boston, Mass.

Grinders, Cock
Windsor Mach. Co., Windsor, Vt.

Grinders, Cutter
Automatic Mach. Co., Greenfield, Mass.
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Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Crocker-Wheeler Co., Ampere, N. J.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett-Dock Co., Boston, Mass.

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Heald Mach. Co., The, Worcester, Mass.
Norton Grinding Co., Worcester, Mass.

Grinders, Disk
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Gardner Machine Co., Beloit, Wis.
Heald Machine Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Iroquois Mach. Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Ransom Mfg. Co., Oshkosh, Wis.
Rowbottom Machine Co., Waterbury, Conn.
Safety Emery Wheel Co., Springfield, O.

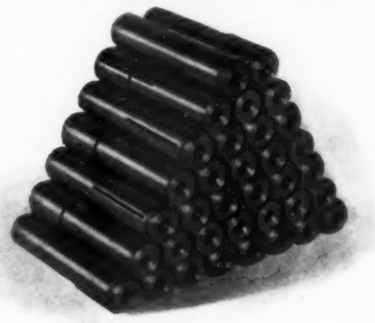
Grinders, Drill
Heald Mch. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinders, Internal
Automatic Mach. Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.

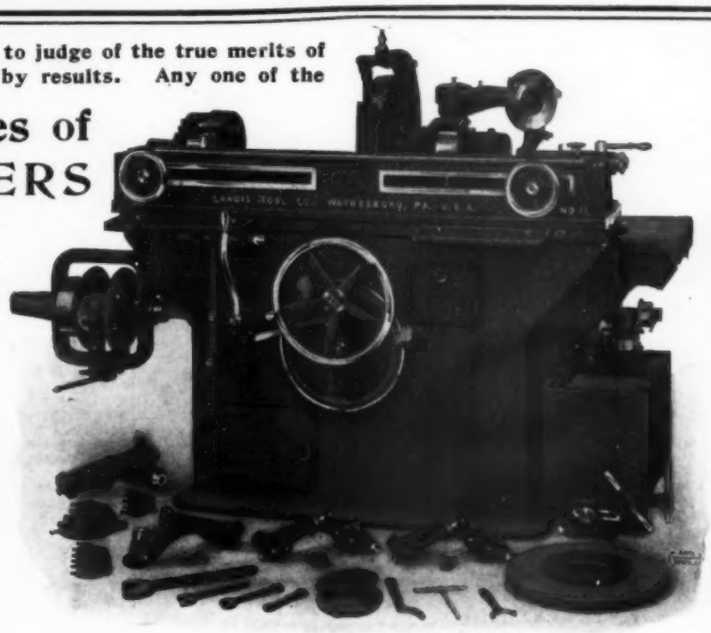
The only way to judge of the true merits of a machine is by results. Any one of the

50 Styles and Sizes of LANDIS GRINDERS

will produce results that commend it to up-to-the-minute manufacturers. Let us know your requirements.



35 PIECES.
Hardened Spindles. 1⅞" and 2⅛" diam., 8¾" long. .035" removed. Average time, 19 min.



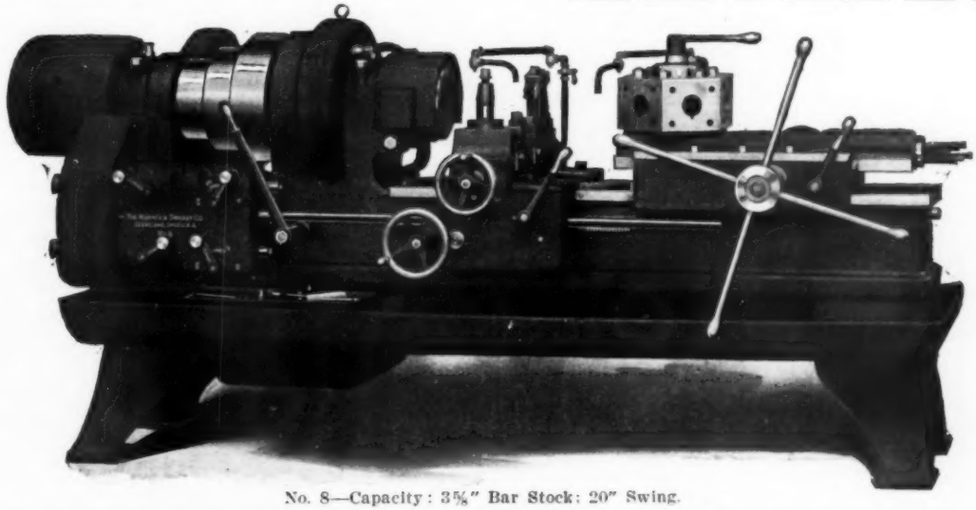
No. 11 LANDIS PLAIN GRINDING MACHINE, 8" swing, 32" between centers.

LANDIS TOOL COMPANY, Waynesboro, Pa., U.S.A.

AGENTS—W. E. Flanders, 309 Schofield Building, Cleveland, Ohio. Walter H. Foster Co., 114 Liberty Street, New York. C. W. Burton, Griffiths & Co., London. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris, Barcelona and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

Turret Screw Machines—NEW DESIGNS

Many important features not embodied in other similar machines: Automatic Chuck—handles stock of any shape. Roller Feed—operated by power. Automatic Feed—gear driven—changes instantly obtainable. Independent Adjustable Stops for turret. Hexagon Turret. Many others—full particulars upon request.



No. 8—Capacity: 3⅝" Bar Stock: 20" Swing.

THE WARNER & SWASEY COMPANY

CLEVELAND, OHIO, U.S.A.

FOREIGN AGENTS: Chas. Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Schuchardt & Schutte, Berlin, Vienna, St. Petersburg and Glasgow. Alfred H. Schutte, Cologne, Paris, Brussels and Milan. H. W. Petrie, Toronto. Williams & Wilson, Montreal.

Grinders, Internal—*Cont'd*
Greenfield Mach. Co., Greenfield, Mass.
Heald Mach. Co., Worcester, Mass.

Grinders, Piston Ring
Heald Mach. Co., Worcester, Mass.

Grinders, Portable
Cincinnati Electrical Tool Co., Cincinnati, O.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Mach. Co., Cincin., O.

Grinders, Tool
Armstrong Bros. Tool Co., Chicago, Ill.
Barnes Co., W. F. & John, Rockford, Ill.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Diamond Mach. Co., Prov., R. I.
Dwight Slate Mach. Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Gould & Eberhardt, Newark, N. J.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hill, Clarke & Co., Boston, Mass.
Hisey-Wolf Mach. Co., Cincin., O.
Landis Tool Co., Waynesboro, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Niles-Bement-Pond Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Walker Co., O. S., Worcester, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grinding and Polishing Machines
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Blount Co., J. G., Everett, Mass.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders' Iron Foundry, Providence, R. I.
Cincinnati Electrical Tool Co., Cincinnati, O.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Diamond Mach. Co., Prov., R. I.
Fairbanks Co., New York.
Gilmore Electric Co., South Boston, Mass.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Mach. Co., Greenfield, Mass.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Heald Mach. Co., Worcester, Mass.
Hisey-Wolf Machine Co., Cin., O.
Independent Pneu. Tool Co., Chicago, Ill.
Iroquois Mach. Co., New York.
Landis Tool Co., Waynesboro, Pa.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Montgomery & Co., New York.
Newton Mach. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Norton Emery Wheel Co., Worcester, Mass.
Norton Grinding Co., Worcester, Mass.
Patterson Tool & Supply Co., Dayton, O.
Prentiss Tool & Supply Co., New York.
Ransom Mfg. Co., Oshkosh, Wis.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Safety Emery Wheel Co., Springfield, O.
Standard Tool Co., Cleveland, O.
Vandyck Churchill Co., New York.
Vitrified Wheel Co., Westfield, Mass.
Walker & Co., O. S., Worcester, Mass.
Webster & Perks Tool Co., Springfield, O.
Wilmarth & Morman Co., Grand Rapids, Mich.

Grinding Wheels
Abrasive Material Co., Philadelphia, Pa.
Adams Co., Dubuque, Iowa.
Builders' Iron Foundry, Providence, R. I.
Carborundum Co., Niagara Falls, N. Y.
Diamond Mach. Co., Prov., R. I.
Hampden Cor. Wheel Co., Brightwood, Mass.
National Corundum Wheel Co., Buffalo, N. Y.
Niles-Bement-Pond Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Safety Emery Wheel Co., Springfield, O.
Superior Corundum Wheel Co., Waltham, Mass.
Vitrified Wheel Co., Westfield, Mass.
Whitney Mfg. Co., Hartford, Ct.

Grindstones and Frames
Athol Mach. Co., Athol, Mass.
Niles-Bement-Pond Co., New York.

Gun Barrel Machinery
Diamond Mach. Co., Prov., R. I.
Pratt & Whitney Co., Hartford, Conn.

Hammers, Drop
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Gould & Eberhardt, Newark, N. J.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toledo Machine Tool Co., Toledo, Ohio.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Hammers, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
Dallett Co., Thos. H., Phila., Pa.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Niles-Bement-Pond Co., New York.

Hammers, Power
Bradley & Son, C. C., Syracuse, N. Y.
Fairbanks Co., New York.
Niles-Bement-Pond Co., New York.
Patterson Tool & Supply Co., Dayton, O.
Prentiss Tool & Supply Co., New York.
Scranton & Co., The, New Haven, Conn.

Hammers, Steam
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Bradley & Son, C. C., Syracuse, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Crescent Forgings Co., Oakmont, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Handles, Machine Tool
Whitman & Barnes Mfg. Co., Chicago, Ill.

Handles, Screw Plate
Standard Welding Co., Cleve., O.

Hangers, Shafting
Cresson Co., Geo. V., Phila., Pa.
Fairbanks Co., New York.
Hyatt Roller Bearing Co., Harrison, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
Wood's Sons, T. B., Chambersburg, Pa.

Heaters, Feed Water
Sturtevant Co., B. F., Hyde Park, Mass.

Heating and Ventilating Apparatus
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Hyde Park, Mass.

Heating Machines
Am. Gas Furnace Co., New York.
Chicago Flexible Shaft Co., Chicago, Ill.

Hoisting and Conveying Machinery
Brown Hoisting Mchry. Co., Cleveland, O.
Caldwell & Son Co., H. W., Chicago, Ill.
Cleveland Crane & Car Co., Wickliffe, O.
Cresson Co., Geo. V., Phila., Pa.
Eastern Mchy. Co., New Haven, Conn.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Engineering Co., Philadelphia, Pa.
Nicholls, Wm. S., New York.
Niles-Bement-Pond Co., New York.
United Engrg. & Fdry. Co., Pittsburg, Pa.

Hoists, Electric
C & C Electric Co., New York.
Cleveland Crane & Car Co., Wickliffe, O.
Crocker-Wheeler Co., Ampere, N. J.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Electric Co., New York.
General Pneu. Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Sprague Electric Co., New York.
Yale & Towne Mfg. Co., New York.

Hoists, Hand
Harrington, Son & Co., Edwin, Philadelphia, Pa.
International Steam Pump Co., New York.
Moore Co., Franklin, Winsted, Conn.
Yale & Towne Mfg. Co., New York.

Hoists, Pneumatic
Cleveland Pneu. Tool Co., Cleveland, O.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneumatic Tool Co. Chicago, Ill.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Nicholls, Wm. S., New York.
Northern Engineering Works, Detroit, Mich.

Hose, Steel
Sprague Elec. Co., New York.

Igniters, Gas Engine
Franklin Mfg. Co., Syracuse, N. Y.

Indicators, Speed
Norton Emery Wheel Co., Worcester, Mass.
Starrett Co., L. S., Athol, Mass.

Indicators, Speed, Peripheral
Warner Instrument Co., Beloit, Wis.

Indicators, Steam Engine
Crosby Steam Gage & Valve Co., Boston, Mass.

Indicators, Test
Reisner Mfg. Co., W. H., Hagerstown, Md.

Industrial Railways
Hunt Co., C. W., West New Brighton, N. Y.

Injectors
Desmond-Stephan Mfg. Co., Urbana, O.
International Specialty Co., Detroit, Mich.
Lunkenheimer Co., Cincinnati, O.
Sellers & Co., Wm., Phila., Pa.

Inspection and Tests
Hunt Co., Robt. W., Chicago, Ill.

Instruction Schools
See Schools, Correspondence.

Instruments, Electric
General Electric Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.

Insurance, Boiler
Hartford Steam Boiler Insp. & Ins. Co., Hartford, Conn.

Iron Filler
Felton, Sibley & Co., Phila., Pa.

Jacks, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Watson-Stillman Co., New York.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill.

Key Seaters
Baker Bros., Toledo, O.
Chattanooga Mchry. Co., Chattanooga, Tenn.
Hill-Standard Mfg. Co., Anderson, Ind.
Lapointe Machine Tool Co., Boston, Mass.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.

Keys, Machine
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Standard Gauge Steel Co., Beaver Falls, Pa.
Whitney Mfg. Co., Hartford, Ct.

Knives, Shear
Phillips & Sons Co., F. R., Philadelphia, Pa.

Knurls
Hammacher, Schlemmer & Co., New York.

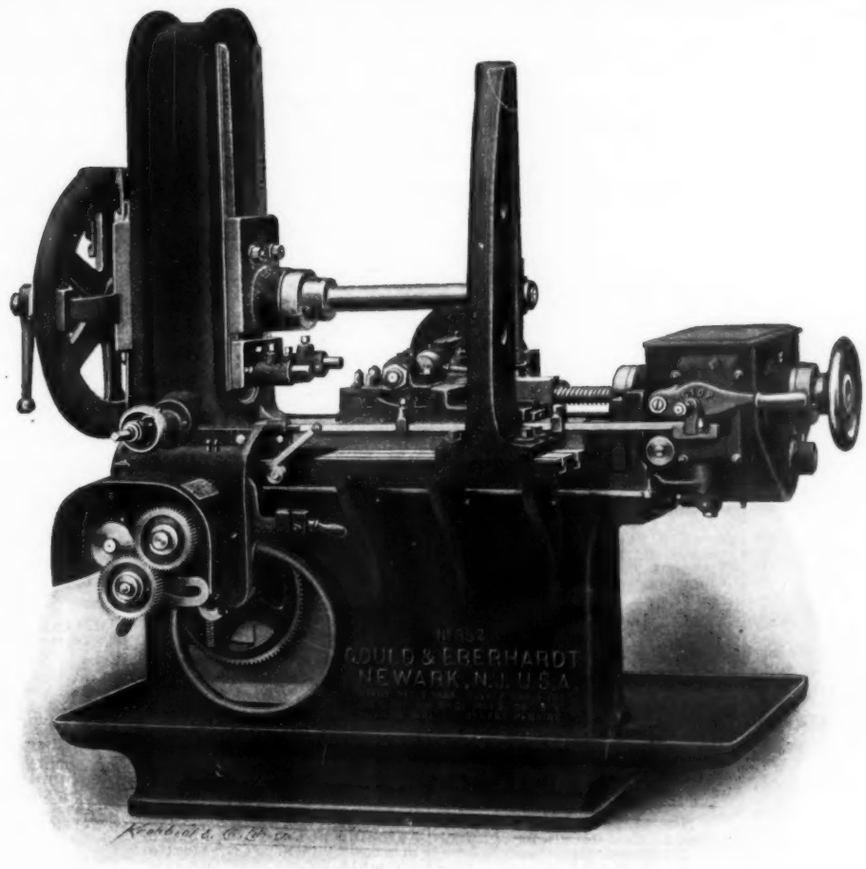
Lamps, Arc
General Electric Co., N. Y. City.
Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lamps, Incandescent
General Electric Co., New York.
Gilmore Electric Co., South Boston, Mass.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Lathe Attachments
American Tool Wks. Co., Cin., O.
Bradford Machine Tool Co., Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Rivett-Dock Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathe Dogs
Armstrong Bros. Tool Co., Chicago, Ill.
Besly & Co., Chas. H., Chicago, Ill.
Hill-Standard Mfg. Co., Anderson, Ind.
Le Count, Wm. G., So. Norwalk, Conn.
Pratt & Whitney Co., Hartford, Conn.
Tindel-Morris Co., Eddystone, Pa.

Lathes
American Tool & Mach. Co., Boston, Mass.
American Tool Works Co., Cin., O.
Automatic Mach. Co., Bridgeport, Conn.
Automatic Mach. Co., Greenfield, Mass.
Barnes Co., W. F. & John, Rockford, Ill.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Blount Co., J. G., Everett, Mass.
Bradford Mach. Tool Co., Cin., O.
Bridgeford Machine Tool Works, Rochester, N. Y.
Bullard Mach. Tool Co., Bridgeport, Conn.
Detrick & Harvey Mach. Co., Baltimore, Md.
Diamond Machine Co., Prov., R. I.
Draper Mach. Tool Co., Worcester, Mass.
Dreses Mach. Tool Co., Cincin., O.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gisholt Machine Co., Madison, Wis.
Greaves, Klusman & Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Mach. Tool Co., Cincinnati, O.



FOR SPUR GEARS ONLY.

You Simply Set The Work and This Machine Will Finish The Gears.

Eberhardt's Patent Automatic Gear-Cutting Machine requires no further attention than the setting and removal of work—strictly automatic. One operator can attend to several machines. No gear cutter on the market has an equal number of mechanical conveniences.

Made in 18 sizes and styles, with or without motor drive.

GOULD & EBERHARDT, Newark, N. J., U. S. A.

SELLING AGENTS—Prentiss Tool and Supply Co., New York, Boston and Buffalo. Baird Machinery Co., Pittsburg, Pa. Marshall & Huschart Machinery Co., Chicago. Motch & Merryweather Machinery Co., Cleveland and Detroit. The Fairbanks Co., Philadelphia and Baltimore. Henshaw, Bulkley & Co., San Francisco. Hallidie Machinery Co., Seattle. W. R. Colcord Machinery Co., St. Louis. C. T. Patterson Co., New Orleans.

FOREIGN AGENTS—Alfred H. Schutte, Cologne, Brussels, Liege, Paris, Milan, Bilbao. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg. Selig, Sonnenthal & Co., London, England. John Lang & Sons, Johnstone, Scotland. Adolfo B. Horn, Havana, Cuba. F. W. Horne, Yokohama, Japan.

Lathes—*Continued*
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Robbins, L., Worcester, Mass.
Schumacher & Boye, Cincinnati, Ohio.
Sebastian Lathe Co., Cincin., O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Shepard Lathe Co., Cincinnati, O.
Springfield Mch. Tool Co., Springfield, O.
Tindel-Morris Co., Eddystone, Pa.
Vandyck Churchill Co., New York.
Von Wyck Mach. Tool Co., Cincinnati, O.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

Lathes, Automatic Screw-Threading
Automatic Machine Co., Bridgeport, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Lathes, Bench
American Watch Tool Co., Waltham, Mass.
Blount Co., J. G., Everett, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Fenn-Sadler Mach. Co., Hartford, Conn.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark Tool Co., Waltham, Mass.
Waltham Machine Works, Waltham, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Lathes, Boring
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Lathes, Brass
Dreses Mach. Tool Co., Cincin., O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Windsor Mach. Co., Windsor, Vt.

Lathes, Extension
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.

Lathes, Foot Power
Barnes Co., W. F. & Jno., Rockford, Ill.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Lathes, Wood
Prentiss Tool & Supply Co., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

Letters, Pattern
Butler, A. G., New York.

Levels
Starrett Co., L. S., Athol, Mass.

Lockers, Clothes
Merritt & Co., Philadelphia, Pa.

Locks
Yale & Towne Mfg. Co., New York.

Locomotives, Electric
General Electric Co., New York.

Lubricants
Besly & Co., Chas. H., Chicago, Ill.
Dixon Crucible Co., Jos., Jersey City, N. J.

Lubricators
Besly & Co., Chas. H., Chicago, Ill.
Crosby Steam Gage & Valve Co., Boston, Mass.
Lunkenheimer Co., Cincinnati, O.

Machinery Dealers
Baird Machy. Co., Pittsburg, Pa.
Durbrow & Hearne Mfg. Co., New York.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Toomey, Frank, Philadelphia, Pa.
Tuohy Bros., New York.
Vandyck Churchill Co., New York.
Wormer Machy. Co., C. C., Detroit, Mich.

Machinists' Small Tools
Athol Mach. Co., Athol, Mass.
Bemis & Call Hardware & Tool Co., Springfield, Mass.
Besly & Co., Chas. H., Chicago, Ill.
Billings & Spencer Co., Hartford, Conn.
Boker & Co., Hermann, New York.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Twist Drill Co., Cleveland, O.
Hammacher, Schlemmer & Co., New York.
Le Count, Wm. G., So. Norwalk, Conn.
Millers Falls Co., New York.
Montgomery & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Pratt & Whitney Co., Hartford, Conn.
Slocomb Co., J. T., Prov., R. I.
Standard Tool Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
Wyke & Co., J., E. Boston, Mass.

Machinists' Supplies
Bemis & Call Hardware & Tool Co., Spirngfield, Mass.
Durbrow & Hearne Mfg. Co., New York.
Frasse Co., Peter A., New York.
Hammacher, Schlemmer & Co., New York.
Montgomery & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Magnets, Lifting
Cutler-Hammer Clutch Co., Milwaukee, Wis.

Mandrels, Expanding
Nicholson & Co., W. H., Wilkesbarre, Pa.

Mandrels, Solid
Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Schellenbach & Radcliffe, Cin., O.
Standard Tool Co., Cleveland, O.
Wells Bros. Co., Greenfield, Mass.

Marking Machines
Dwight Slate Mach. Co., Hartford, Conn.

Measuring Machines
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.

Mechanical Draft
Sturtevant Co., B. F., Hyde Park, Mass.

Metal, Bearing
Besly & Co., Chas. H., Chicago, Ill.
Patterson, Gottfried & Hunter, Ltd., New York.
Phillips & Sons Co., F. R., Philadelphia, Pa.

Meters, Electric
General Electric Co., New York.
Stanley G. I. Electric Mfg. Co., Pittsfield, Mass.

Micrometer Calipers
Brown & Sharpe Mfg. Co., Providence, R. I.
Slocomb Co., J. T., Providence, R. I.
Starrett Co., L. S., Athol, Mass.

Milling Attachments
Adams Co., Dubuque, Iowa.
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Kempsmith Mfg. Co., Milwaukee, Wis.
Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Bench
American Watch Tool Co., Waltham, Mass.
Niles-Bement-Pond Co., New York.
Rivett Lathe Mfg. Co., Boston, Mass.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Hand
Prentiss Tool & Supply Co., New York.
Whitney Mfg. Co., Hartford, Ct.
Brown & Sharpe Mfg. Co., Providence, R. I.

Milling Machines, Horizontal
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Cincinnati Mill. Mach. Co., Cincinnati, O.
Hendey Mch. Co., Torrington, Ct.
Hess-Bright Mfg. Co., Phila., Pa.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Kempsmith Mfg. Co., Milwaukee, Wis.
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.

Milling Machines, Plain
Adams Co., Dubuque, Iowa.
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Dwight Slate Mach. Co., Hartford, Conn.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mch. Co., Torrington, Ct.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.
McCabe, J. J., New York.
Marshall & Huschart Mchry. Co., Chicago, Ill.
Motch & Merryweather Machinery Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Warner & Swasey Co., Cleveland, Ohio.
Whitney Mfg. Co., Hartford, Ct.

Milling Machines, Portable
Underwood & Co., H. B., Philadelphia, Pa.

Milling Machines, Universal
American Tool Wks. Co., Cin., O.
Aurora Tool Works, Aurora, Ind.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mach. Co., Cincinnati, O.
Fairbanks Co., New York.
Garvin Mach. Co., New York.
Hendey Mach. Co., Torrington, Conn.
Kempsmith Mfg. Co., Milwaukee, Wis.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

Milling Machines, Universal
Continued
McCabe, J. J., New York.
Marshall & Huschart Mach. Co., Chicago, Ill.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.
Waltham Watch Tool Co., Springfield, Mass.

Milling Machines, Vertical
Adams Co., Dubuque, Iowa.
Beaman & Smith Co., Prov., R. I.
Becker-Brainard Milling Mach. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clough, R. M., Tolland, Conn.
Garvin Mach. Co., New York.
Ingersoll Mill. Mach. Co., Rockford, Ill.
Newton Mch. Tool Works, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Owen Mach. Tool Co., Springfield, Ohio.
Prentiss Tool & Supply Co., New York.
Vandyck Churchill Co., New York.

Milling Tools, Adjustable
Geometric Tool Co., New Haven, Conn.
Rogers Boat, Gage & Drill Wks., John M., Gloucester City, N. J.

Mining Machinery
Ingersoll-Rand Co., New York.

Mixing and Sifting Machines, Sand
Gould & Eberhardt, Newark, N. J.
Link-Belt Engineering Co., Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

Molding Machines
Adams Co., The, Dubuque, Iowa.
Mumford Co., The E. H., Philadelphia, Pa.
Tabor Mfg. Co., Philadelphia, Pa.
Webster & Perks Tool Co., Springfield, O.

Mortising Machines, Chain
New Britain Mach. Co., New Britain, Conn.

Motors, Electric
Burke Elec. Co., Erie, Pa.
C & C Electric Co., New York.
Coates Clipper Mfg. Co., Worcester, Mass.
Crocker-Wheeler Co., Ampere, N. J.
Eck Dynamo & Motor Works, Belleville, N. J.
Electro Dynamic Co., Bayonne, N. J.
General Electric Co., New York.
Independent Pneumatic Tool Co., Chicago, Ill.
Jantz & Leist Elec. Co., Cin., O.
Northern Electric Mfg. Co., Madison, Wis.
Ridgway Dynamo & Engine Co., Ridgway, Pa.
Sprague Electric Co., New York.
Stanley G. I. Elec. Mfg. Co., Pittsfield, Mass.
Sturtevant Co., B. F., Hyde Park, Mass.
Triumph Elec. Co., Cincinnati, O.
Westinghouse Elec. & Mfg. Co., Pittsburg, Pa.

Name Plates
Crowe Name Plate & Eng. Co., Chicago, Ill.
Franklin Mfg. Co., Syracuse, N. Y.

Nurls
Montgomery & Co., New York.

Nut Tappers
See Bolt and Nut Machinery.

Oil Separators
American Tool & Mach. Co., Boston, Mass.

Oil Stones
Norton Emery Wheel Co., Worcester, Mass.

Packing, Steam
Jenkins Bros., New York.

Packings, Hydraulic and Pneumatic
Watson-Stillman Co., New York.

Paints and Enamels, Machinery
Felton, Sibley & Co., Phila., Pa.

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Kilbourne & Jacobs Mfg. Co., Columbus, O.

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Mersfelder Pattern Co., Cin., O.

Pattern Shop Machinery and Supplies
Baker Bros., Toledo, O.
Blount Co., J. G., Everett, Mass.
Greaves, Klusman & Co., Cin., O.
Prentiss Tool & Supply Co., New York.
Robbins, L., Worcester, Mass.
Rowbottom Machine Co., Waterbury, Conn.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Whitcomb-Blaisdell Mach. Tool Co., Worcester, Mass.

Pencils
Dixon Crucible Co., Jos., Jersey City, N. J.

Pinion Cutters
American Watch Tool Co., Waltham, Mass.
Gould & Eberhardt, Newark, N. J.

Pipe Cutting and Threading Machines
Bignall & Keeler Mfg. Co., Edwardsville, Ill.
Curtis & Curtis Co., Bridgeport, Conn.
Merrell Mfg. Co., Toledo, O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Saunders' Sons, D., Yonkers, N. Y.
Standard Engineering Works, Ellwood City, Pa.
Stoever Fdry. & Mfg. Co., Myerstown, Pa.
United Engrg. & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Wells Bros. Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Pipe Fitters' Tools
Cleveland Twist Drill Co., Cleveland, O.
Saunders' Sons, D., Yonkers, N. Y.
Standard Tool Co., Cleveland, O.

Planer Attachments
Cincinnati Planer Co., Cincin., O.
Gray Co., G. A., Cincinnati, O.

Planers
American Tool Wks. Co., Cin., O.
Bartlett, E. E., Boston, Mass.
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Betts Mach. Co., Wilmington, Del.
Bigram, Hugo, Philadelphia, Pa.
Cincinnati Planer Co., Cincin., O.
Detrick & Harvey Mch. Co., Baltimore, Md.
Fairbanks Co., New York.
Fitchburg Machine Works, Fitchburg, Mass.
Garvin Mach. Co., New York.
Gray Co., G. A., Cincinnati, O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Hendey Mach. Co., Torrington, Ct.
McCabe, J. J., New York.
Motch & Merryweather Machinery Co., Cleveland, O.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Ridgway Machine Tool Co., Ridgway, Pa.
Sellers & Co., Wm., Phila., Pa.
Vandyck Churchill Co., New York.
Whitcomb-Blaisdell Machine Tool Co., Worcester, Mass.
Woodward & Powell Planer Co., Worcester, Mass.

Planers, Portable
Morton Mfg. Co., Muskegon Heights, Mich.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Planers, Rotary
Newton Mach. Tool Wks., Philadelphia, Pa.
Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Precision Machinery
American Watch Tool Co., Waltham, Mass.
Faneuil Watch Tool Co., Boston, Mass.
Rivett Lathe Mfg. Co., Boston, Mass.
Stark Tool Co., Waltham, Mass.

Presses, Broaching
Prentiss Tool & Supply Co., New York.
Watson-Stillman Co., New York.

Presses, Drop
American Tube & Stamping Co., Bridgeport, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Miner & Peck Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.

Presses, Forging
Niles-Bement-Pond Co., New York.

Presses, Hand
Bliss Co., E. W., Brooklyn, N. Y.

Presses, Hydraulic
Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Ridgway Mach. Tool Co., Ridgway, Pa.
Watson-Stillman Co., New York.

Presses, Power
American Tube & Stamping Co., Bridgeport, Conn.
Automatic Mach. Co., Bridgeport, Conn.
Bethlehem Fdry. & Mch. Co., So. Bethlehem, Pa.
Billings & Spencer Co., Hartford, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Chambersburg Engineering Co., Chambersburg, Pa.
Dill Machine Works, T. C., Philadelphia, Pa.
Fairbanks Co., New York.
Lucas Mach. Tool Co., Cleve., O.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.
Springfield Mch. Tool Co., Springfield, O.
Toledo Machine Tool Co., Toledo, Ohio.
Vandyck Churchill Co., New York.
Waterbury Farrel Fdry. & Mach. Co., Waterbury, Conn.

Presses, Screw
Barnes Co., W. F. & Jno., Rockford, Ill.

Profilers
American Watch Tool Co., Waltham, Mass.
Becker-Brainard Mill. Mach. Co., Hyde Park, Mass.
Garvin Mach. Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.

Publishers
Audel, Theo., New York.
Henley Pub. Co., Norman W., New York.
Hill Pub. Co., New York.
Modern Machinery Publishing Co., Chicago, Ill.

Pulleys
American Pulley Co., Phila., Pa.
American Tool & Mach. Co., Boston, Mass.
Caldwell & Son Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machy. Co., New Haven, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Reeves Pulley Co., Columbus, Ind.
Taylor-Wilson Mfg. Co., Allegheny, Pa.
Wilmarth & Morman Co., Grand Rapids, Mich.
Wood's Sons, T. B., Chambersburg, Pa.

Pulley Turning and Boring Machines
American Tool Wks. Co., Cin., O.
Harrington, Son & Co., Edwin, Philadelphia, Pa.
Niles-Bement-Pond Co., New York.

Pumps, Air
Ingersoll-Rand Co., New York.

Pumps, Electric
General Electric Co., New York.

Pumps, Hydraulic
General Electric Co., New York.
Watson-Stillman Co., New York.

Pumps, Steam
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Montgomery & Co., New York.

Punches, Centering
Brown & Sharpe Mfg. Co., Providence, R. I.
Hammacher, Schlemmer & Co., New York.
Niagara Mach. & Tool Wks., Buffalo, N. Y.

Punches, Hydraulic
Bethlehem Fdry. & Mach. Co., So. Bethlehem, Pa.
Niles-Bement-Pond Co., New York.
United Engrg. & Fdry. Co., Pittsburg, Pa.
Watson-Stillman Co., New York.
Williams, White & Co., Moline, Ill.

Punches, Power
Bertram & Sons Co., Ltd., John, Dundas, Ont., Canada.
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Bliss Co., E. W., Brooklyn, N. Y.
Hilles & Jones Co., Wilmington, Del.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.
United Engrg. & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.

Rack Cutting Machines
Adams Co., Dubuque, Iowa.
Dwight Slate Mach. Co., Hartford, Conn.
Fellows Gear Shaper Co., Springfield, Vt.
Gould & Eberhardt, Newark, N. J.
Le Blond Mach. Tool Co., R. K., Cincinnati, O.

Racks, Cut
Bair & Gazzam Mfg. Co., Pittsburg, Pa.
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Gould & Eberhardt, Newark, N. J.
Nuttall Co., R. D., Pittsburg, Pa.
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Massey Mach. Co., Watertown, N. Y.
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American Gas Furnace Co., New York.

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Boker & Co., Hermann, New York.
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Lapointe Mach. Tool Co., Boston, Mass.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
New Process Twist Drill Co., Taunton, Mass.
Pratt & Whitney Co., Hartford, Conn.
Rogers, John M., Boat, Gage & Drill Works, Gloucester City, N. J.
Schellenbach & Radcliffe, Cin., O.
Standard Tool Co., Cleveland, O.
Three Rivers Tool Co., Three Rivers, Mich.
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Regulators, Voltage
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Chambersburg Engineering Co., Chambersburg, Pa.
Niles-Bement-Pond Co., New York.
Watson-Stillman Co., New York.

Riveters, Pneumatic
Dallett Co., Thos. H., Phila., Pa.
General Pneumatic Tool Co., Montour Falls, N. Y.
Independent Pneu. Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Prentiss Tool & Supply Co., New York.

Riveters, Steam
Chambersburg Engineering Co., Chambersburg, Pa.

Riveting Machines
Bethlehem Foundry & Mach. Co., So. Bethlehem, Pa.
Independent Pneumatic Tool Co., Chicago, Ill.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Roller and Ball Bearings
Auburn Ball Bearing Co., Rochester, N. Y.
Ball Bearing Co., Phila., Pa.
Boston Gear Wks., Boston, Mass.
Hess-Bright Mfg. Co., Phila., Pa.
Hyatt Roller Bearing Co., Harrison, N. J.
Pressed Steel Mfg. Co., Philadelphia, Pa.
Standard Roller Bearing Co., Philadelphia, Pa.

Roller Mills, Coining
Dill Mach. Works, T. C., Philadelphia, Pa.

Rolling Mill Machinery
Birdsboro Steel Fdry. & Mach. Co., Birdsboro, Pa.
Dill Mach. Works, T. C., Philadelphia, Pa.
Fawcus Mach. Co., Pittsburg, Pa.
Hilles & Jones Co., Wilmington, Del.
Niles-Bement-Pond Co., New York.
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Rules, Steel
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Hammacher, Schlemmer & Co., New York.
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